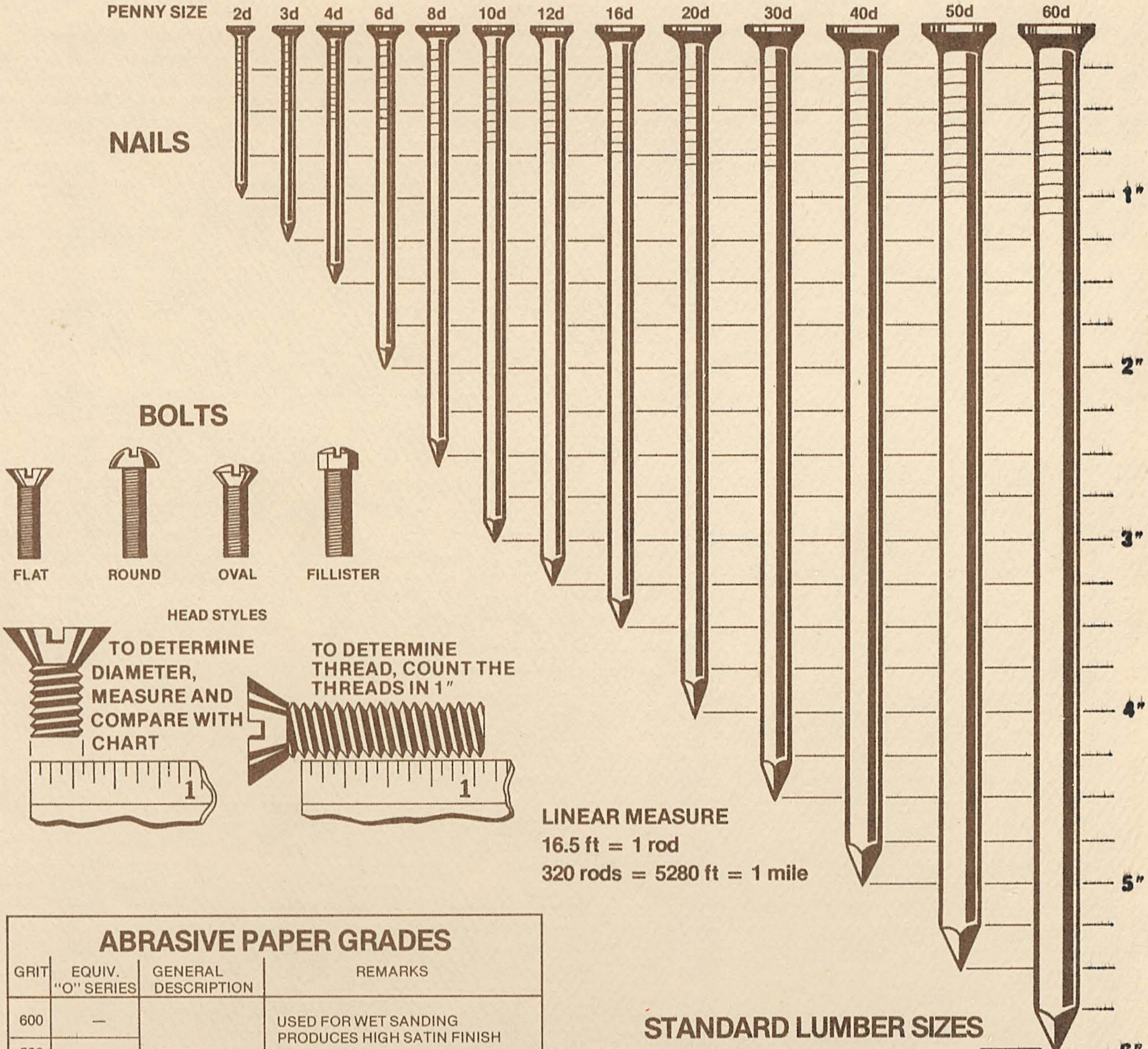
Popular Mechanics

do-it-yourself encyclopedia

SHOP GUIDE



TO DETERMINE DIAMETER, MEASURE AND COMPARE WITH CHART

TO DETERMINE THREAD, COUNT THE THREADS IN 1"

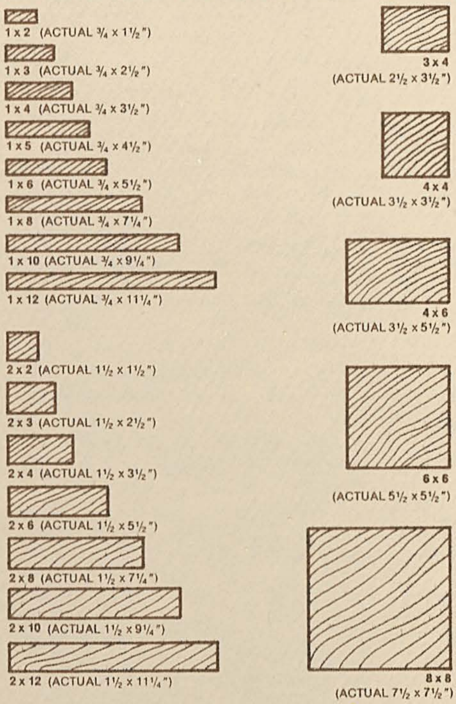
LINEAR MEASURE
16.5 ft = 1 rod
320 rods = 5280 ft = 1 mile

ABRASIVE PAPER GRADES

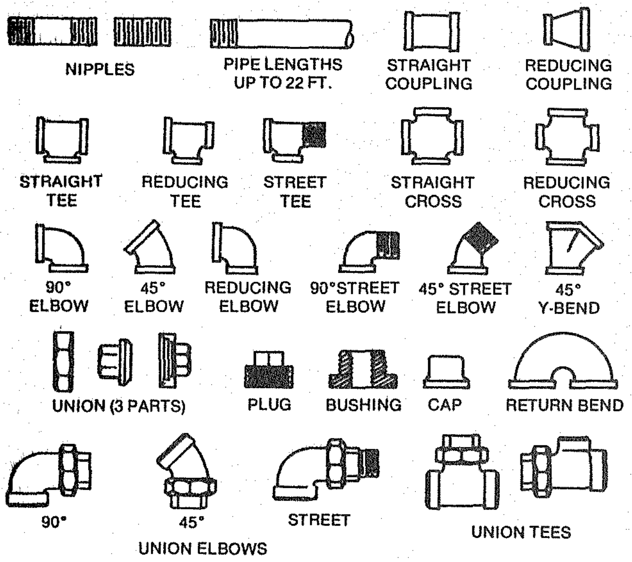
GRIT	EQUIV. "O" SERIES	GENERAL DESCRIPTION	REMARKS
600	—	SUPER-FINE	USED FOR WET SANDING PRODUCES HIGH SATIN FINISH
500	—		
400	10/0		GENERAL RANGE OF ABRASIVE PAPERS USED FOR WET SANDING LACQUER AND VARNISH TOP COATS
360	—		
320	9/0		
280	8/0	VERY FINE	USED FOR DRY SANDING ALL FINISHING UNDERCOATS. THESE GRADES WILL NOT SHOW SANDING MARKS
240	7/0		
220	6/0*		
180	5/0	FINE	FOR FINAL SANDING OF BARE WOOD. GOOD FOR SMOOTHING OLD PAINT
150	4/0*		
120	3/0	MEDIUM	USE FOR GENERAL WOOD SANDING. GOOD FOR FIRST SMOOTHING OF OLD PAINT, PLASTER PATCHES
100	2/0*		
80	1/0		
60	½*	COARSE	USE No. ½ FOR ROUGH-WOOD SANDING. No. 1 IS COARSEST PAPER WHICH CAN BE USED TO ADVANTAGE WITH PAD SANDER
50	1		
40	1½		
36	2	VERY COARSE	ALL TOO COARSE FOR PAD SANDERS. THESE GRADES REQUIRE HEAVY MACHINES AND HIGH SPEED TO CUT WELL
30	2½		
24	3		

Grades generally supplied as Very Fine, Fine, Medium and Coarse

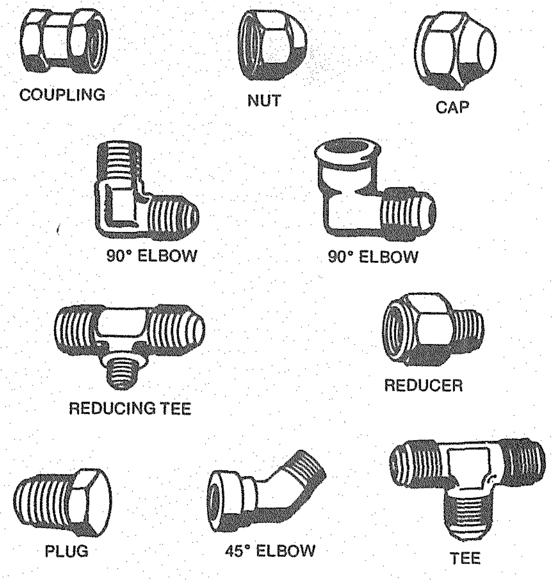
STANDARD LUMBER SIZES



PIPE FITTINGS



Here are the common steel pipe fittings. Nipples are simply short lengths of pipe threaded on both ends. Reducing fittings join two different sizes of pipe.



Compression fittings of the flared-tube type are the easiest for the novice to handle when working with copper tubing.

STANDARD STEEL PIPE
(All Dimensions in Inches)

Nominal Size	Outside Diameter	Inside Diameter	Nominal Size	Outside Diameter	Inside Diameter
⅛	0.405	0.269	1	1.315	1.049
¼	0.540	0.364	1¼	1.660	1.380
⅜	0.675	0.493	1½	1.900	1.610
½	0.840	0.622	2	2.375	2.067
¾	1.050	0.824	2½	2.875	2.469

SQUARE MEASURE

144 sq in = 1 sq ft
9 sq ft = 1 sq yd
272.25 sq ft = 1 sq rod
160 sq rods = 1 acre

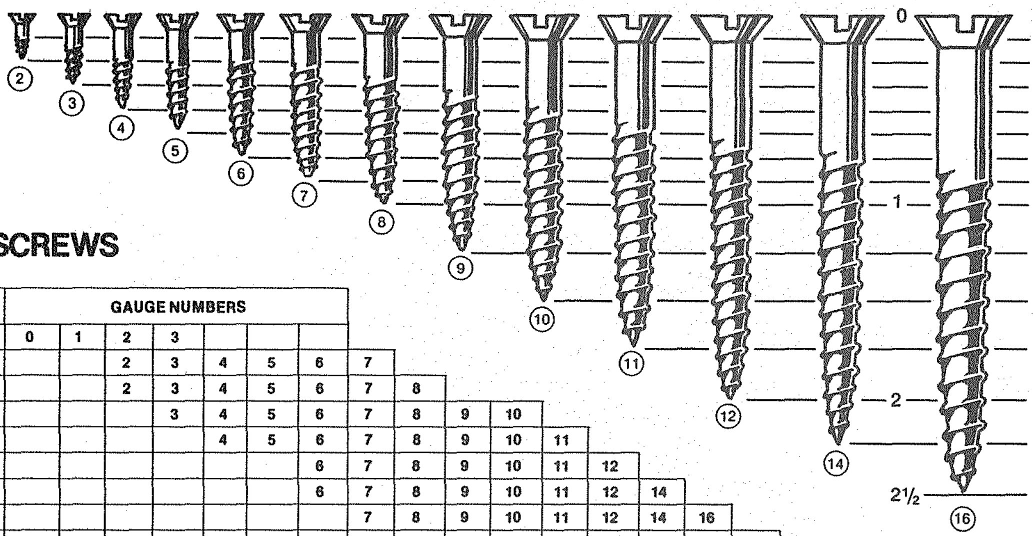
VOLUME MEASURE

1728 cu in = 1 cu ft
27 cu ft = 1 cu yd

MEASURES OF CAPACITY

1 cup = 8 fl oz
2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
2 gallons = 1 peck
4 pecks = 1 bushel

WOOD SCREWS



LENGTH	GAUGE NUMBERS																	
¼ INCH	0	1	2	3														
⅜ INCH			2	3	4	5	6	7										
½ INCH			2	3	4	5	6	7	8									
⅝ INCH				3	4	5	6	7	8	9	10							
¾ INCH					4	5	6	7	8	9	10	11						
⅞ INCH							6	7	8	9	10	11	12					
1 INCH							6	7	8	9	10	11	12	14				
1¼ INCH								7	8	9	10	11	12	14	16			
1½ INCH							6	7	8	9	10	11	12	14	16	18		
1¾ INCH									8	9	10	11	12	14	16	18	20	
2 INCH									8	9	10	11	12	14	16	18	20	
2¼ INCH										9	10	11	12	14	16	18	20	
2½ INCH													12	14	16	18	20	
2¾ INCH														14	16	18	20	
3 INCH															16	18	20	
3½ INCH																18	20	24
4 INCH																18	20	24

WHEN YOU BUY SCREWS, SPECIFY (1) LENGTH, (2) GAUGE NUMBER, (3) TYPE OF HEAD—FLAT, ROUND, OR OVAL, (4) MATERIAL—STEEL, BRASS, BRONZE, ETC., (5) FINISH—BRIGHT, STEEL BLUED, CADMIUM, NICKEL, OR CHROMIUM PLATED.

In this volume . . .

HERE'S AN ELEGANT electric serving cart—a plug-in warmer under a lift-up top that keeps side dishes piping hot. See plans on page 2692.

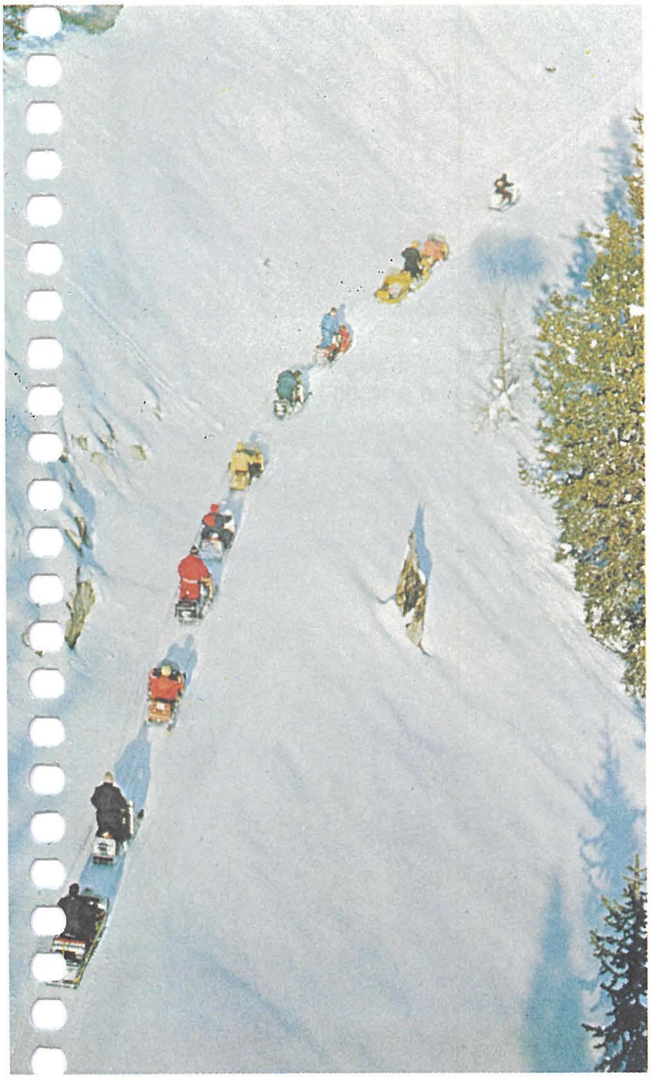
"HEAR THOSE BIRDS, old friend? Be ready, because they'll be here soon." It's a thrill only a hunter can know. But everything depends upon the scattergun he holds. Check how to select a shotgun, page 2768.

THERE'S UNTOLD EXCITEMENT in soaring high against the sky, pivoting, then plunging down through the soft snow. But only if you take care of your skis. See page 2790.

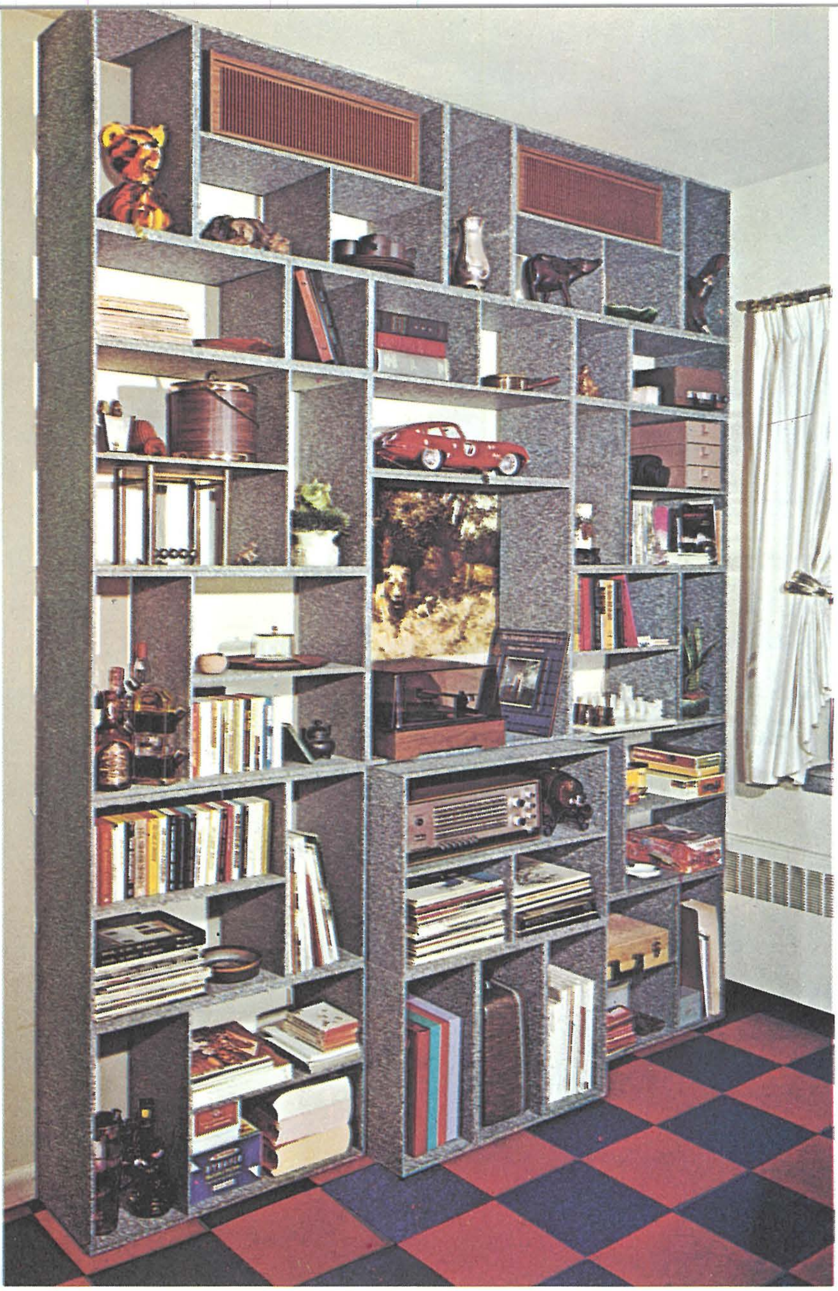
SKIMMING DOWN a mountain can be a great adventure—if your machine is in top shape.

FOLLOW THE LEADER along an icy mountain stream, in the vast majesty of the mountains.

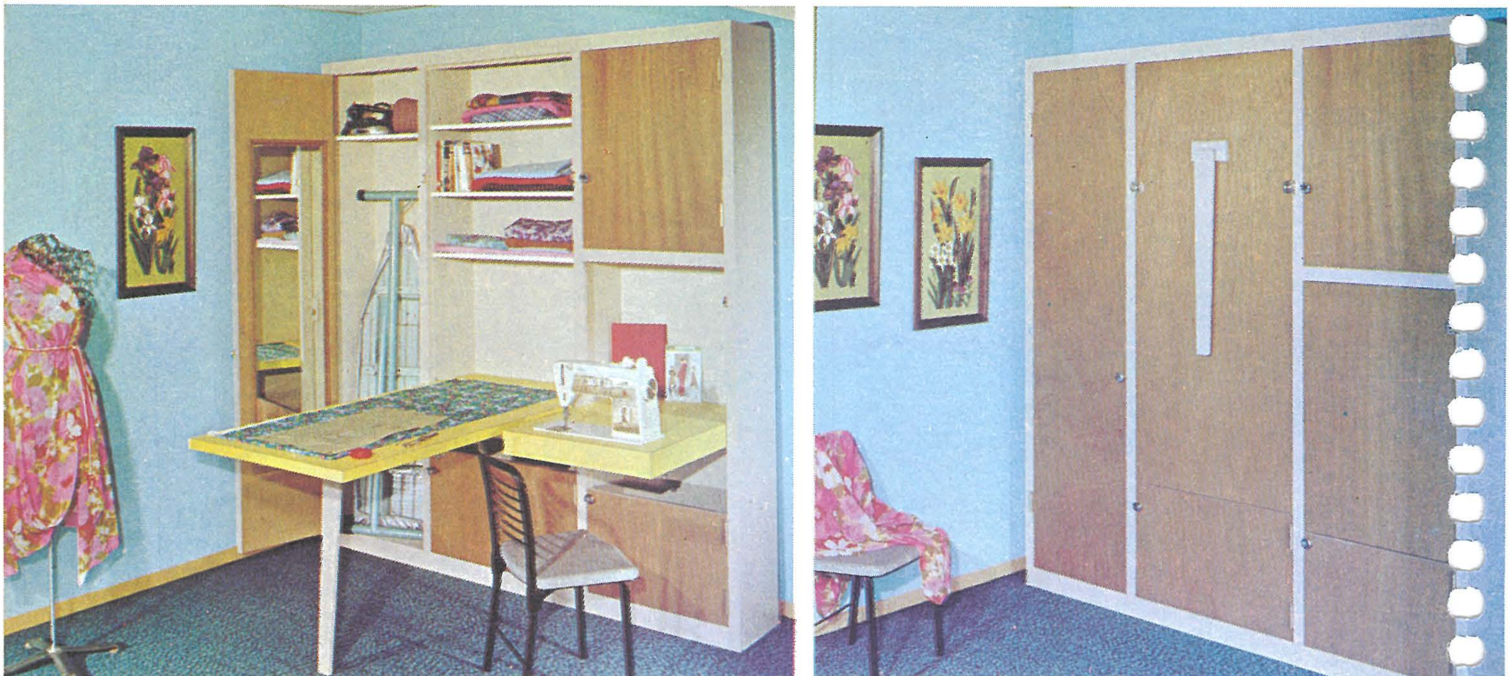
SCALE THE HEIGHTS, one after another, then pause in the snow beneath a tree. Snowmobilers have a special feeling toward their machines. See "Get ready for snow" page 2822.



HERE'S A UNIQUE approach to portable furniture that you can take with you when you move from apartment to apartment or house to house. You build shelf units in modules, which then can be stacked in a good many different ways. See the article on page 2746.



BELOW YOU SEE a complete sewing center, with built-in sewing machine, storage, and a generous cutting table. On page 2702 you'll find this sewing center and others. Make one soon!



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- burglary and fire protection
- furniture projects
- finishing and refinishing furniture
- outdoor living
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- solutions to home problems
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- model making
- weekend projects
- workshop shortcuts and techniques
- hand-tool skills
- power-tool know-how
- shop-made tools
- car repairs
- car maintenance
- appliance repair
- boating
- hunting
- fishing
- camping
- photography projects
- radio, TV and electronics know-how
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- projects just for fun

volume 15

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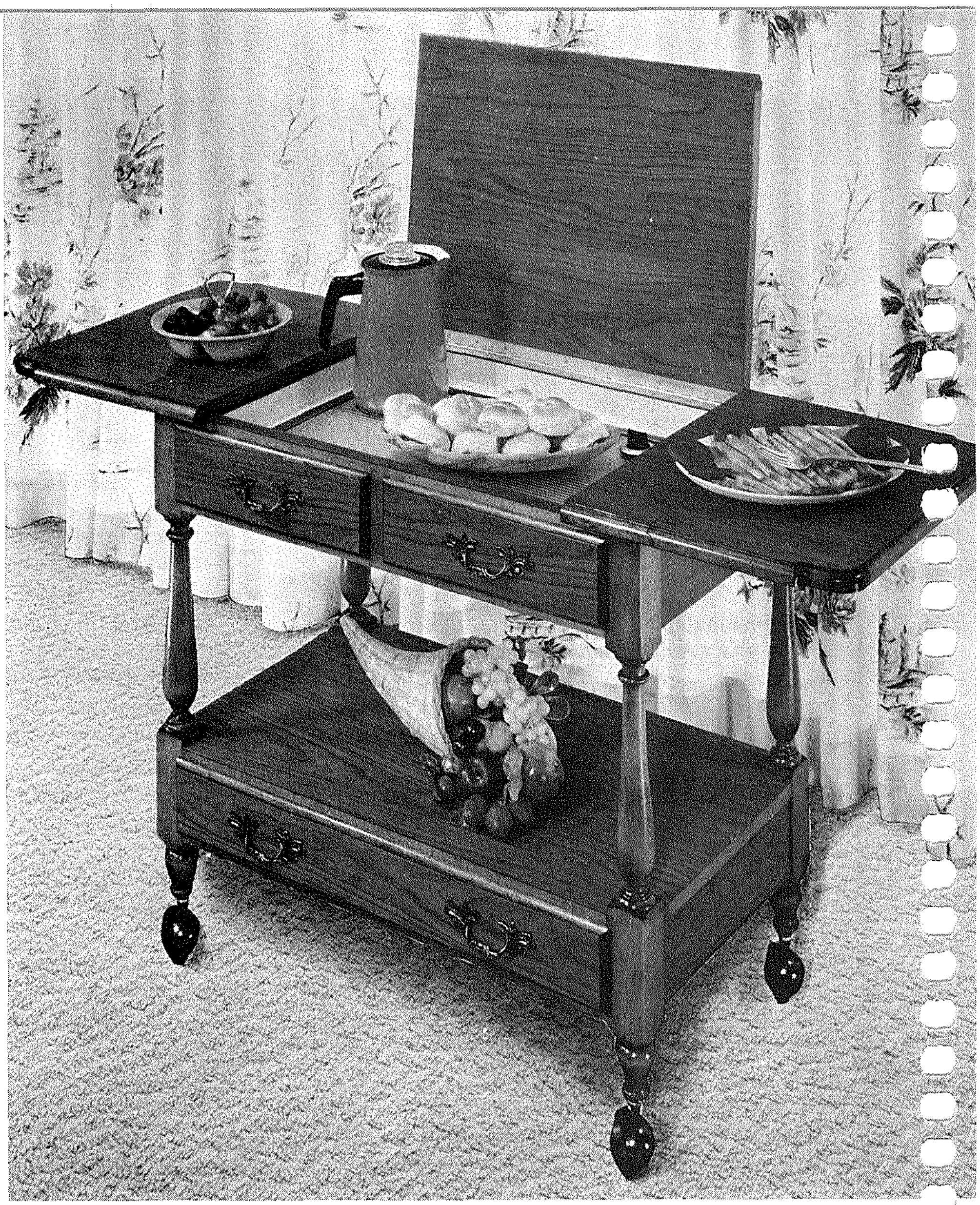


This serving cart features a durable plastic laminate top. A plug-in food warmer under a lift-up top keeps side dishes piping hot and flavor perfect when you entertain

By WAYNE C. LECKEY

Build an electric serving cart

IF YOU MAKE the mistake of showing your wife this elegant early American serving cart, you might just as well start building it. She won't give you a moment's peace until you do.

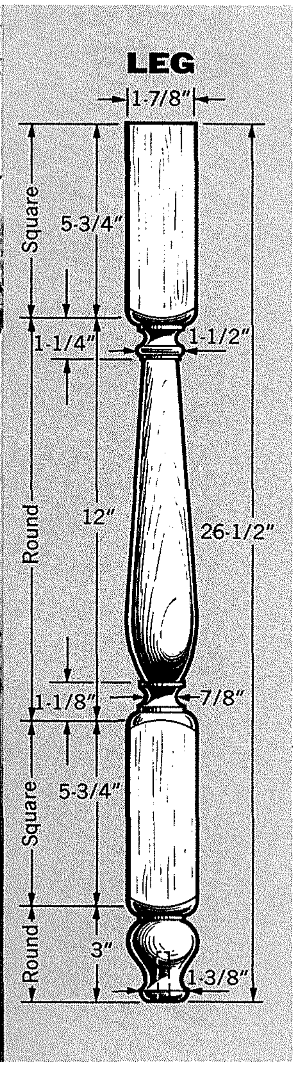
That's how much she'll love its rich fruitwood finish, its built-in electric warming tray, its retractable cord, its felt-lined silver and linen drawer and its easy-rolling ball casters.

You'll need such special tools as a wood lathe and router, but don't worry about being an expert at finishing. Its slick finish is a decorative laminate—you just cement it on and that's it.

We covered the original cart with Consoweld's Colonial cherry and used solid cherry for the turned legs and exposed edges of the top, drop leaves, drawer fronts, lower shelf and front crossrails. These surfaces were later stained and finished to closely match the cherry laminate.

First turn the four legs from 1⅞-in. turning squares. To turn all four alike, make a full-size cardboard template to mark off the round and square sections of the leg. Mount each turning between centers so the top of the leg is at the headstock end of the lathe. This way, with a bit in the tailstock, you'll be able to bore holes dead-center in the ends of the legs for casters.

SEE ALSO
**Dining tables . . . Kitchen accessories . . .
Mobile furniture . . . Servers**



Take caliper readings directly from the template.

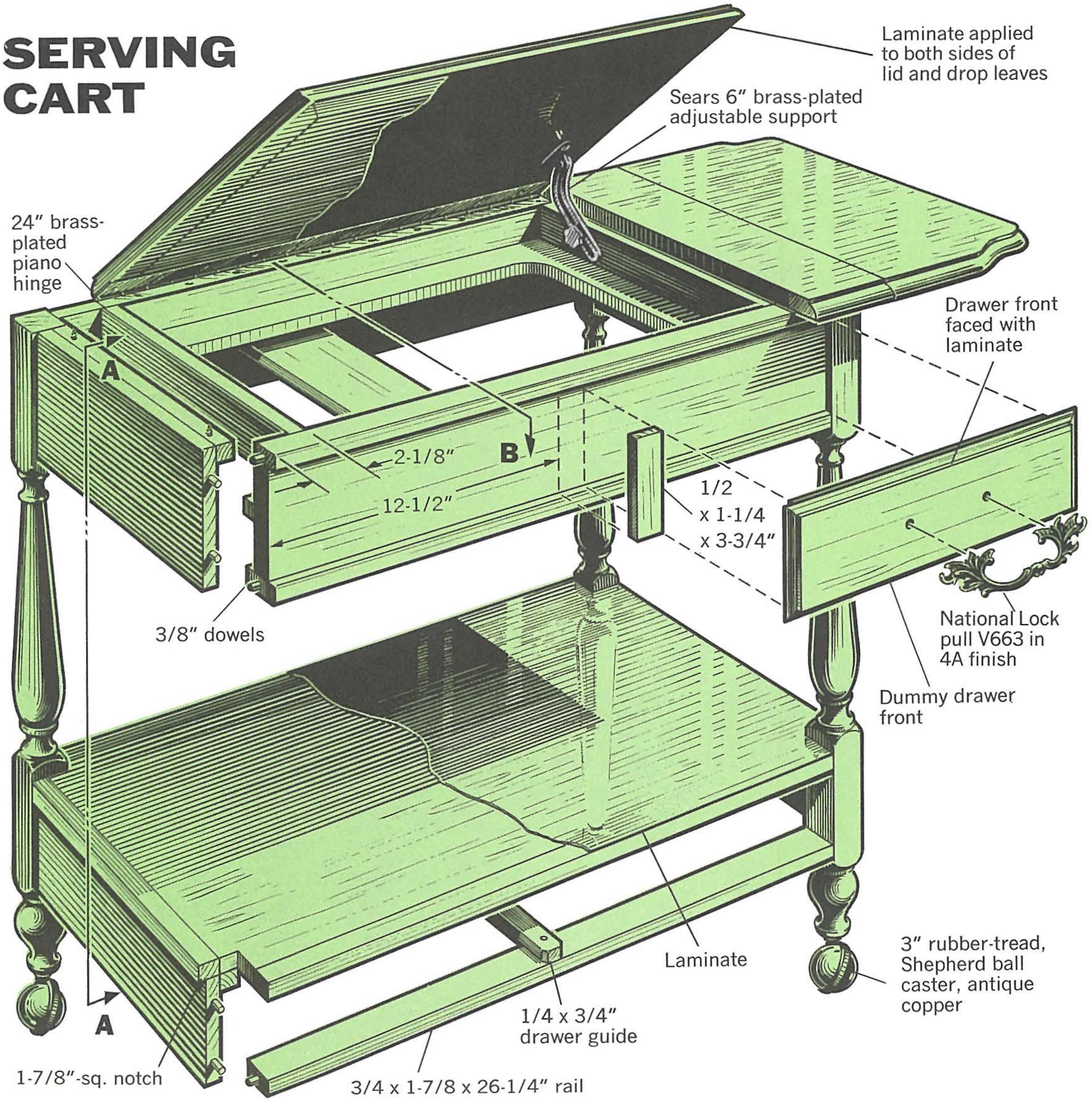
Next cut the four end aprons. The two top ones are 5¼ in. wide; the two bottom ones are 4⅜ in. Cover the aprons with laminate before you trim them to size and bore the dowel holes. The upper aprons are kept even with the tops of the legs and 3/16 in. in from the face. The lower aprons are ¾ in. from being centered on the square portion of the leg to allow for the bottom shelf which rests on them. Now dowel and glue the aprons to the legs. Cover and cut the top and bottom back aprons to size and bore for dowels. They're 26¼ in. long and the same widths as the end aprons, set in the same amount and cut from fir plywood.

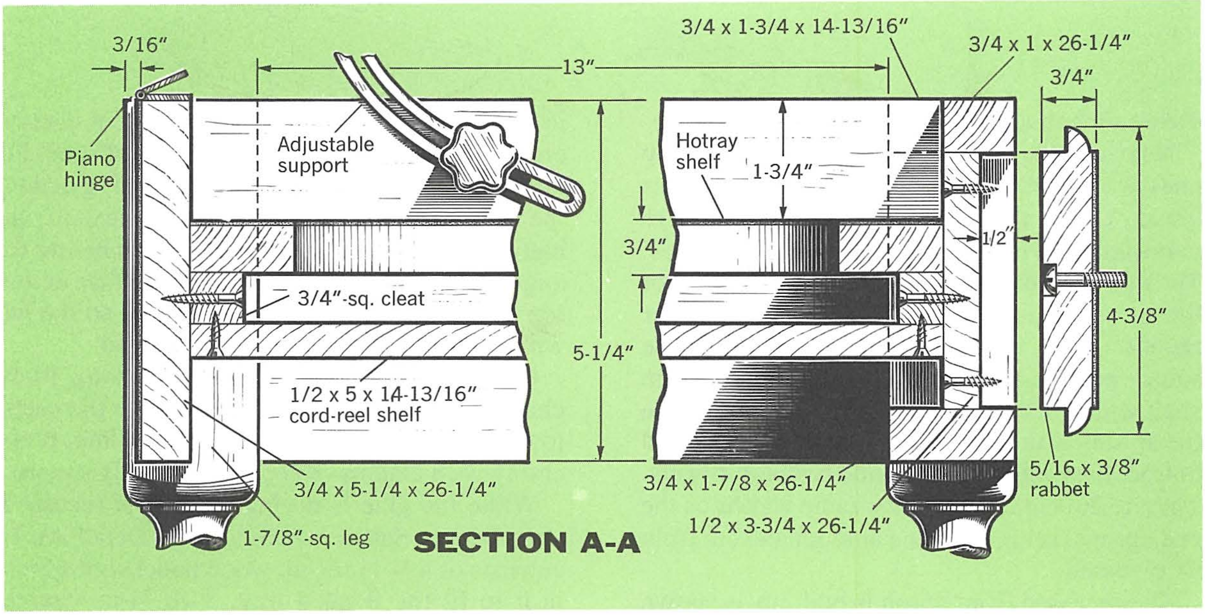
The recessed front apron is built up as shown in section A-A. Top and bottom rails of cherry are glued and nailed to a center piece of ½-in. fir plywood. Then a filler block of cherry is glued to the front to divide the recessed apron exactly in half. The ends are bored for dowels as before to align with holes in the legs. The top surface of the top rail is later covered with laminate so the lid will be flush with the rest when closed.

Cut the lower crossrail 26¼ in. long from cherry and bore for dowels. Now glue the parts to the end assemblies. Do this at one time, preferably with clamps. Keep the assembly square.

While the glue is drying, make the recessed shelf for the Salton warming tray (Detail A). It consists of a ¾-in. fir-plywood panel with a hole in it to fit the flanged tray. Two ¾-in.-square

SERVING CART


Laminate applied to both sides of lid and drop leaves
Sears 6" brass-plated adjustable support
24" brass-plated piano hinge
A
B
2-1/8"
12-1/2"
1/2 x 1-1/4 x 3-3/4"
Drawer front faced with laminate
3/8" dowels
National Lock pull V663 in 4A finish
Dummy drawer front
Laminate
3" rubber-tread, Shepherd ball caster, antique copper
A
1-7/8"-sq. notch
1/4 x 3/4" drawer guide
3/4 x 1-7/8 x 26-1/4" rail



SECTION A-A

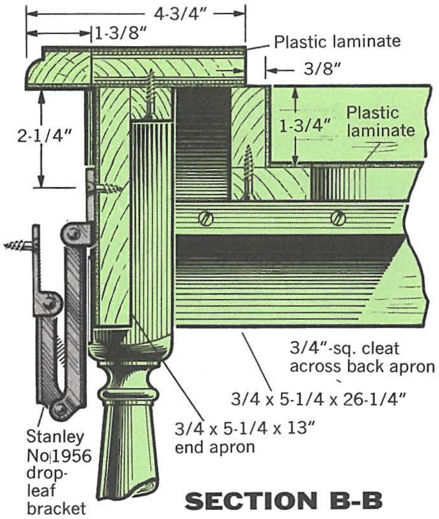
cleats are glued to the front and back edges, and two ¾ x 1¾-in. members are glued on edge at the ends. (Here it's wise to check the 14¹³/₁₆-in. dimension against the actual inside width of the cart.)

Since the tray shelf is also faced with laminate, it's easier to cover it before it's installed. We covered the shelf top and inside surfaces of the ends with yellow laminate. After installing it, we added 1¾-in.-wide strips of the laminate to exposed parts of the aprons. The ½ x 5-in. crossmember, screwed to the shelf cleats, supports the self-winding cord reel.

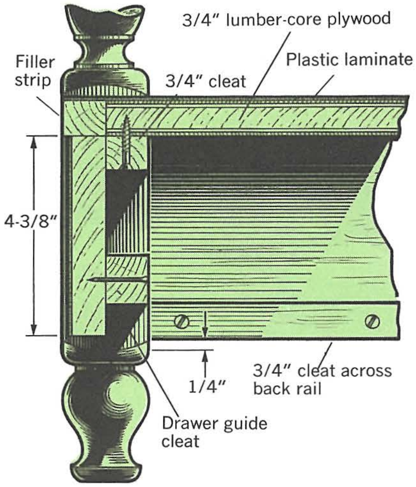
To make the bottom shelf, glue ¾ x 1-in. strips of cherry to the edges of a plywood center panel, notch the corners for legs and cover the top with laminate. Attach the completed shelf to the cart with screws through cleats glued to the end aprons. (Study section B-B.)

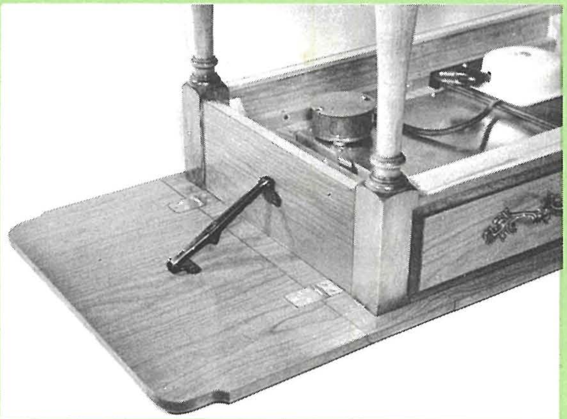
Make the lid, top and drop-leaf parts essentially the same way, but make the edge pieces 1½ in. wide and miter the corners. Note that the narrow top sections are banded only on three edges. Both top and bottom surfaces of the five top parts are covered with laminate, then the edges are shaped. Use a standard drop-leaf cutter and its mate to shape the hinged edges. The other edges can be shaped with less of a shoulder or even with a different-shaped cutter. Mortise the drop-leaf table hinges flush with the laminate. Be sure the barrels of the hinges are centered exactly on the shoulder of the shaped edge.

Attach the narrow top sections to the cart with cleats and screws from below and let them overhang the ends 1⅜ in. The lid should fit between

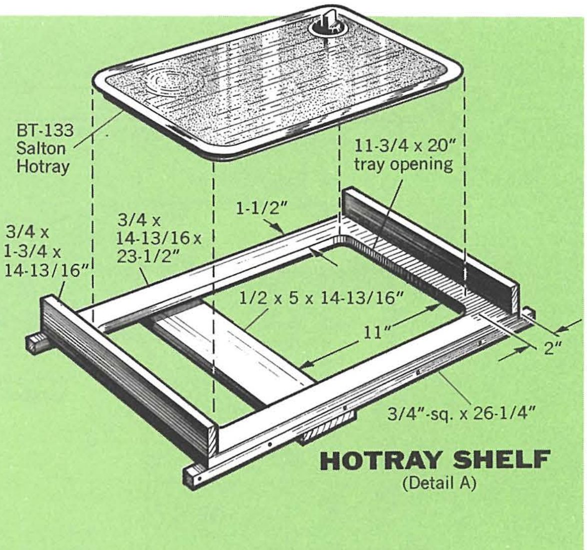

4-3/4"
1-3/8"
Plastic laminate
3/8"
Plastic laminate
1-3/4"
2-1/4"
3/4"-sq. cleat across back apron
3/4 x 5-1/4 x 26-1/4"
3/4 x 5-1/4 x 13" end apron
Stanley No. 1956 drop-leaf bracket

SECTION B-B





UNDERSIDE view of drop leaf shows bracket which holds leaf up. It's surface-mounted with four screws.



HOTRAY SHELF
(Detail A)

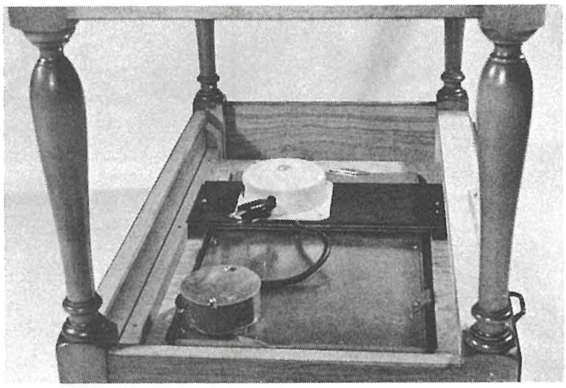
the two with $^1/_{16}$-in. clearance at each side. It's hinged at the back with a piano hinge mortised flush with the laminate. The lid should overhang front and back ¾ in. Adding an adjustable support like the one shown completes the lid. Fit the drop leaves with surface-mounted, spring-loaded brackets.

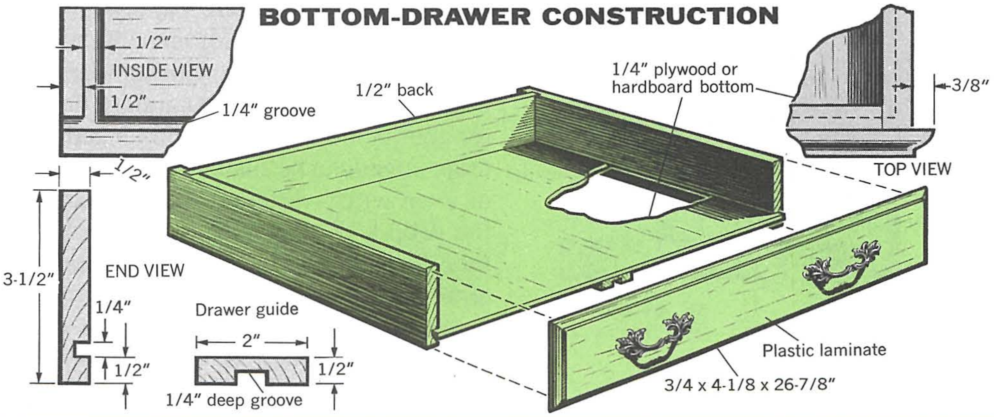
The drawers complete the job. The two upper ones are dummies, of course; they're actually made and attached before laminate is applied to the inside of the tray shelf. The fronts are pieces of cherry, rabbeted around the back, faced with laminate and shaped. Attach the pulls before you screw the fronts in place.

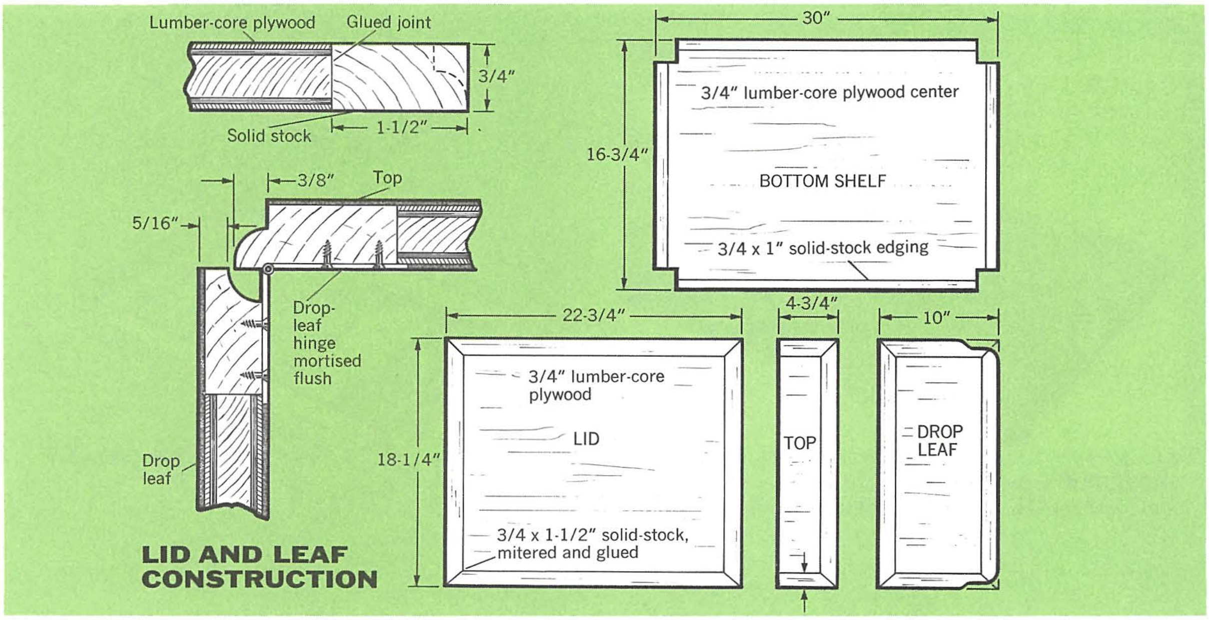
Make the front of the bottom drawer as just described, and the rest is typical drawer assembly (see construction details, below). Attach a grooved guide to the bottom to ride on a rail screwed to the front crossrail and to a cleat added to the back apron. Note in section B-B how drawer rubrails are nailed to the end aprons.

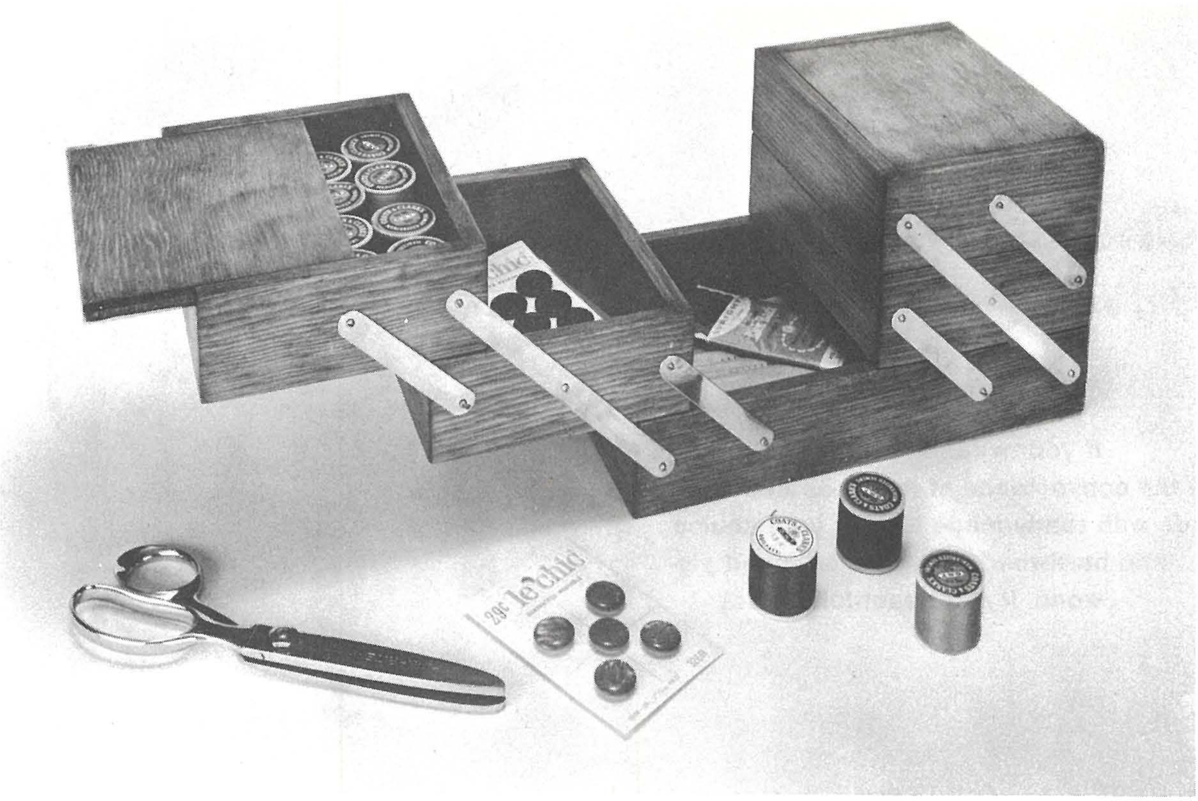
Wire the plug-in Acopian cord reel to a junction box mounted on the tray bottom. Use wire suited for 167° F., and be sure the tray is properly grounded.

A RETRACTABLE REEL, which holds 6 ft. of cord, is wired to the junction box that comes with the tray.




BOTTOM-DRAWER CONSTRUCTION

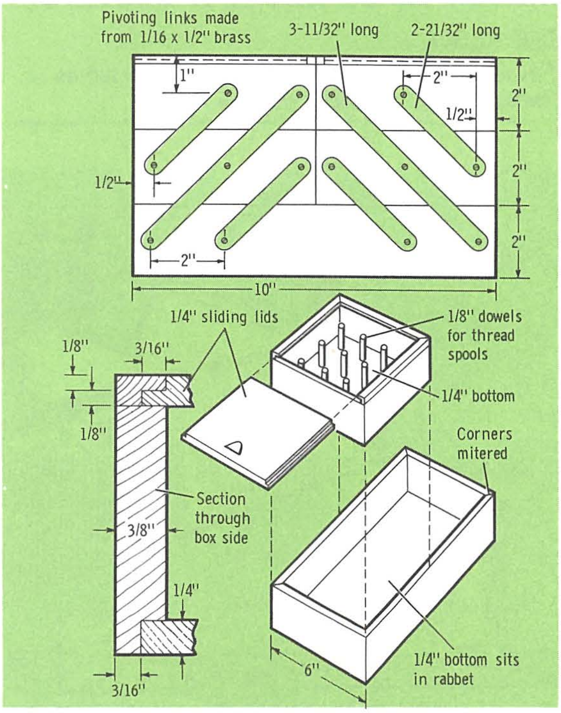

LID AND LEAF CONSTRUCTION



Swing-up sewing box

YOUR WIFE WILL find this novel sewing box a handy place to store her sewing supplies. It's a stack of boxes linked together to swing open in unison. Four of the box-like trays are basically alike, except two have sliding lids. The latter are rabbeted on three sides to slide in grooves formed by nailing ¼ x ⅜-in. rabbeted strips to the box. Box bottoms and lids are ¼-in. thick, while the sides are ⅜-in. thick.

You'll need 12 links of 1/16 x ½-inch flat brass—eight short ones and four long. Drill all of equal size at the same time to assure identical spacing of the holes. The links are placed at a 45° angle and you'll find that you'll do best to locate the short ones first, 1 in. down from the top and ½ in. in from the sides. Use the smallest round-headed screws you can find to pivot the links, and don't draw them up too tight. The bottoms of the two top trays are drilled for short ⅛-in. dowels to provide spindles for spools of thread.

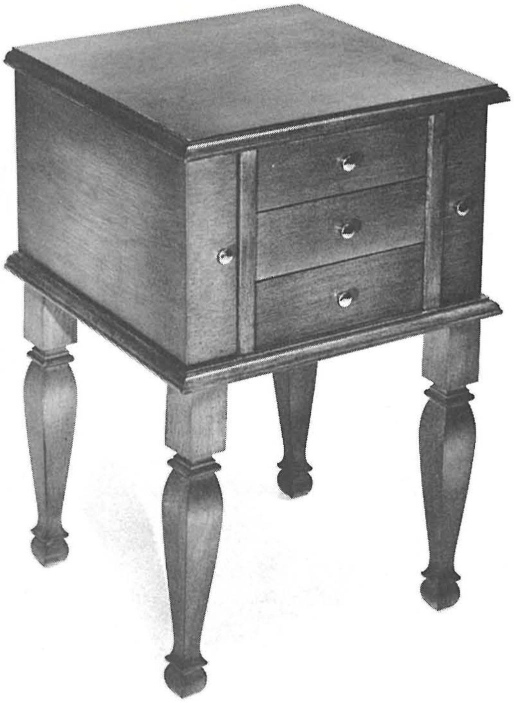


SEE ALSO

Boxes, trinket . . . Jewelry boxes . . .
Modular furniture . . . Sewing cabinets . . .
Sewing centers . . . Storage ideas . . . Trinket chests

Chairside sewing cabinet

If your wife likes to sew, she will love the convenience of this chairside companion. Made with ready-made legs of your choice and hardwood or hardwood-faced plywood, it is a beautiful project



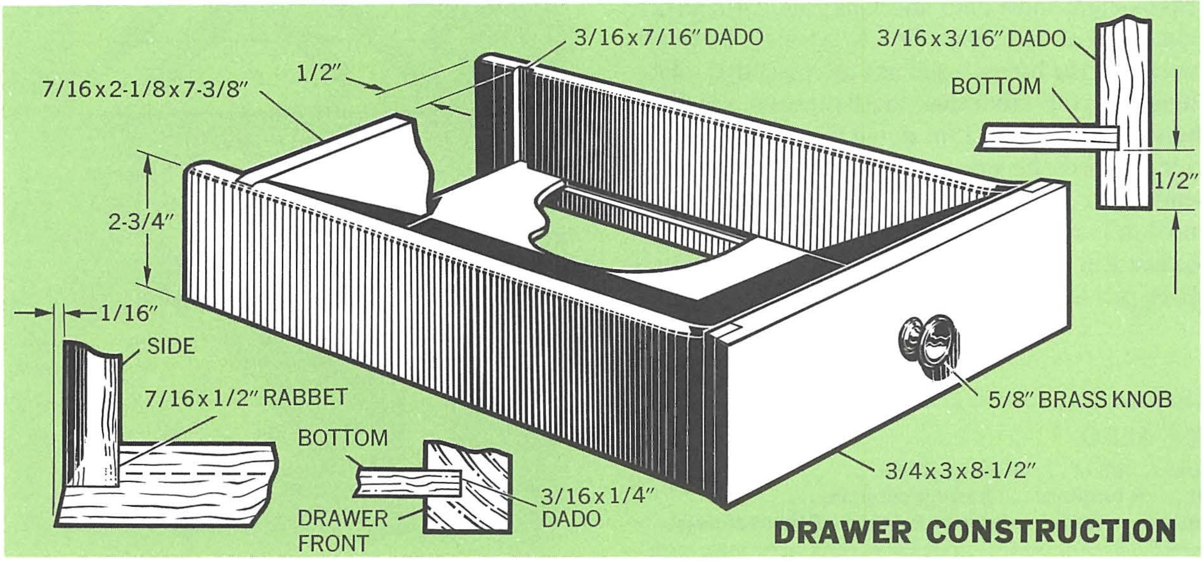
■ HERE'S A PROJECT that is fun to make and is sure to please your wife. Construction is simplified by using ready-made legs that you can buy in many different shapes and merely screw in place.

While it will necessitate gluing up boards, you'll have a more handsome piece if you build it of solid stock—walnut, birch or cherry. Not only will you be able to shape the top and bottom edges as indicated, but you'll have no problem in finishing all edges. However, if you skip the shaping of the edges of the top and bottom members and leave them square, you can use hardwood-faced plywood and cover the exposed wood with glue-on-flexible wood tape.

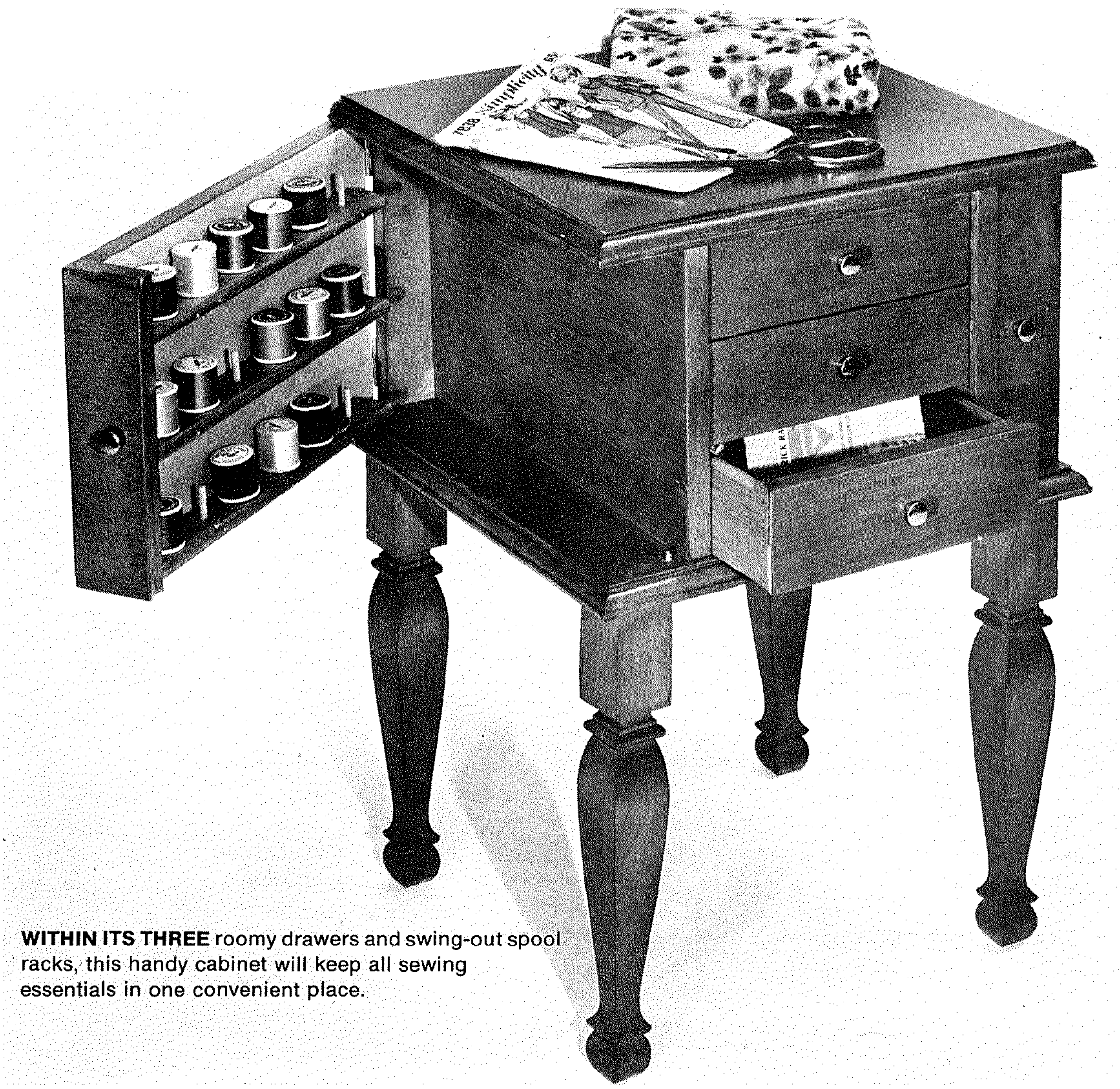
SEE ALSO

Drawers . . . Hobby centers . . . Occasional tables . . . Sewing boxes . . . Sewing centers

Start with the two inner side members. These are alike but are made right and left-hand when you're running the dadoes on the inside for the



DRAWER CONSTRUCTION



WITHIN ITS THREE roomy drawers and swing-out spool racks, this handy cabinet will keep all sewing essentials in one convenient place.

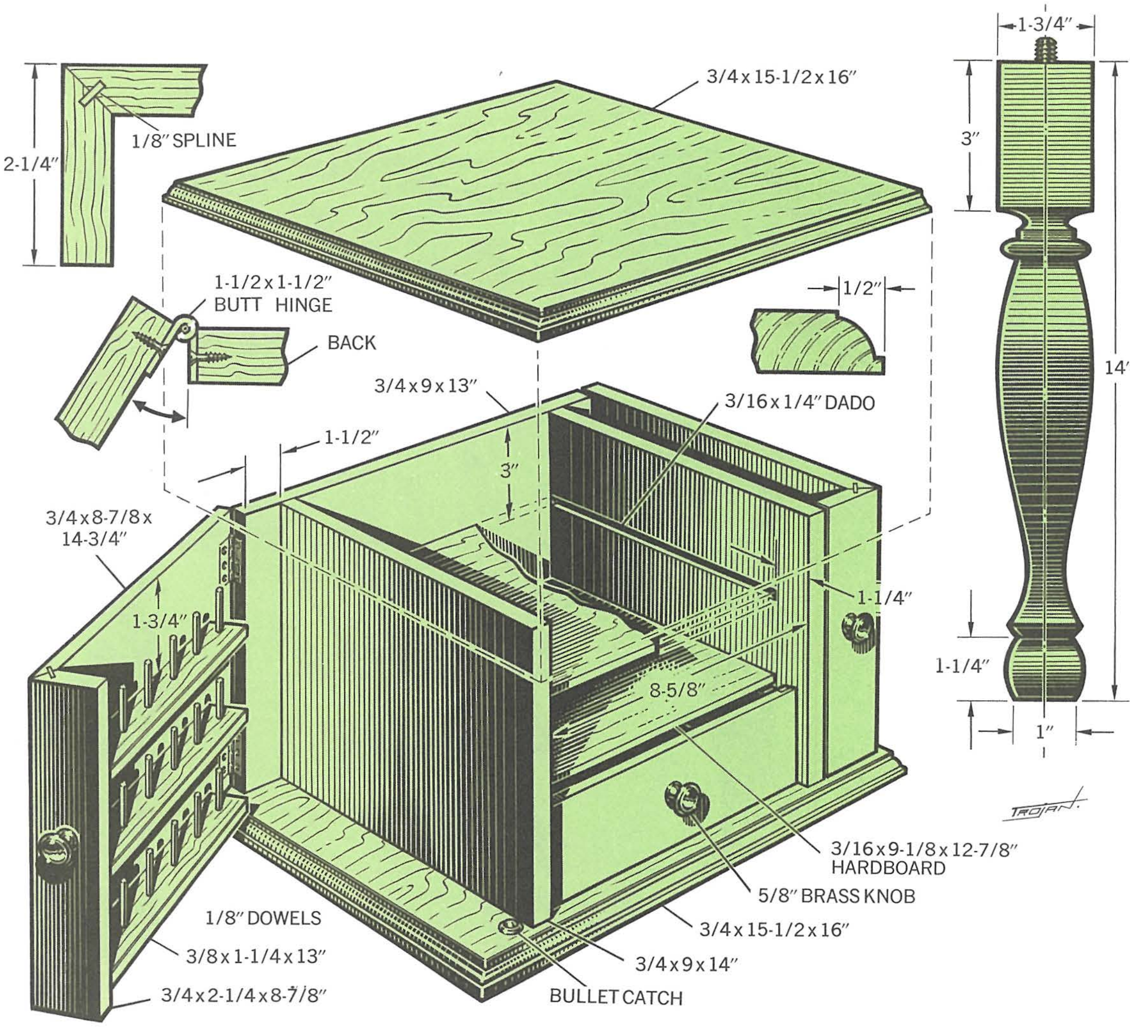
two $^3/_{16}$-in. drawer shelves. Notice that the ¼-in.-deep dadoes are stopped 1¼ in. from the front edges and then finished up by hand with a narrow chisel. If they're made with a router, you won't have to chisel them. Cut the upper dado 3 in. down from the top.

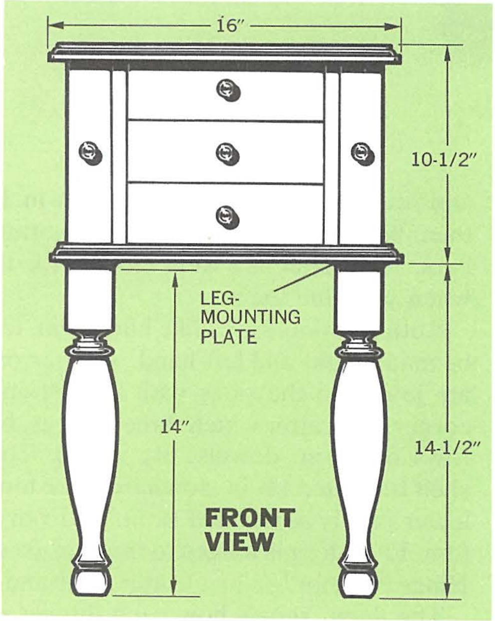
The back is the same height as the sides and is simply a plain, square-edge member. Before it can be nailed and glued to the sides, the two drawer shelves must be in place. Notice that the back member projects 1½ in. past the sides.

After gluing up stock to a width of 15½ in. cut the top and bottom members 16 in. long. They're shaped only along three sides, not the back. You'll notice that spring-loaded bullet catches are used to "lock" the swing-out spool doors, and you'll be smart if you bore the ¼-in. holes for them before you add the top and bottom members. The latter are kept flush with the back when you glue them.

Both side doors are alike but, again, they must be made right- and left-hand. The narrow fronts are joined to the sides with a miter-and-spline corner joint, after which three shelves, bored for rows of ⅛-in. dowels, are added. The upper shelf is located 1¾ in. down from the top and the lower one is positioned ⅛ in. up from the bottom. Each door is hinged to the back (see detail). Hinge them for $^1/_{16}$-in. clearance top and bottom.

The detail shows how each drawer is made. You should actually fit them to their openings, leaving enough clearance all around for free slid-





ing. The fronts are ¾-in. stock; sides and backs are ⅜-in. The fronts are also ⅛ in. higher than the sides to lap and conceal the drawer shelves. Notice that rabbeted ends of the drawer fronts have a slight inward bevel. This assures ample side clearance for the drawer itself without a sloppy fitting front. Notice, too, that the drawers set back in ¼ in. A thumbtack at each front corner of the lower opening will keep the bottom drawer from rubbing on the cabinet and marring its finish.

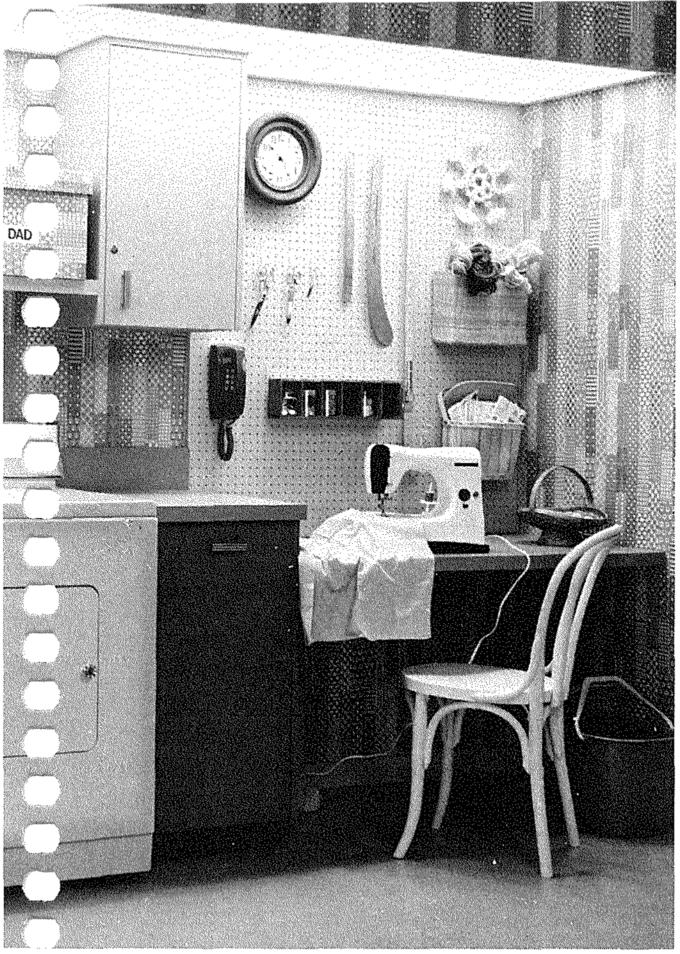
If you own a router or shaper, you can give the drawers a factory-made look by rounding the top edges of the side members. You would do this, of course, before the drawers are assembled and stop the cutter at a point where the side enters the rabbet. Your cabinet is completed when you add small brass knobs.

Ideas for sewing built-ins

SINCE MENDING is often done in connection with washing clothes, a logical place for a sewing built-in is the laundry room. Complete with portable machine and a pegboard wall to hold patterns and sewing essentials, plus a clock and phone, the built-in sewing nook at left is an idea from Maytag that makes good sense.

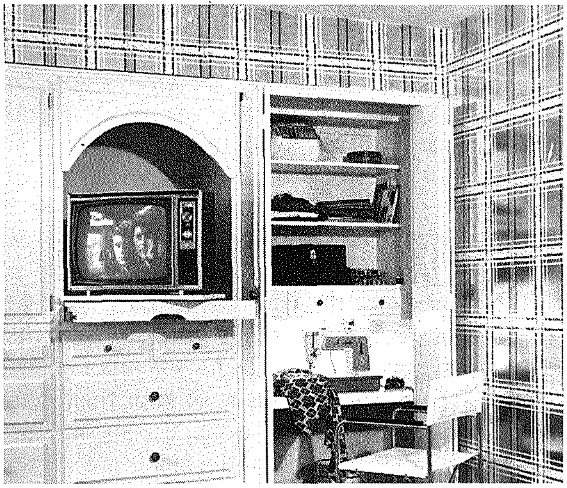
Three flush doors supported by four two-drawer file cabinets placed along a wall make a complete sewing center (below, right). The file cabinets provide eight roomy storage drawers for yard goods and patterns galore, and the long counter gives all the room in the world to lay out and cut a pattern.

An unusual way to find space for a convenient sewing center is in a spare bedroom closet (below). Folding doors cover the opening when you close up shop for the day.



BUILT-IN NEXT to the washer and the clothes bin, this tidy sewing center is handy for sewing a rip in Junior's jeans. After the mending is complete the washing machine is right there to throw the dirty clothes in. Behind the machine is a pegboard wall to hold scissors and other sewing essentials.

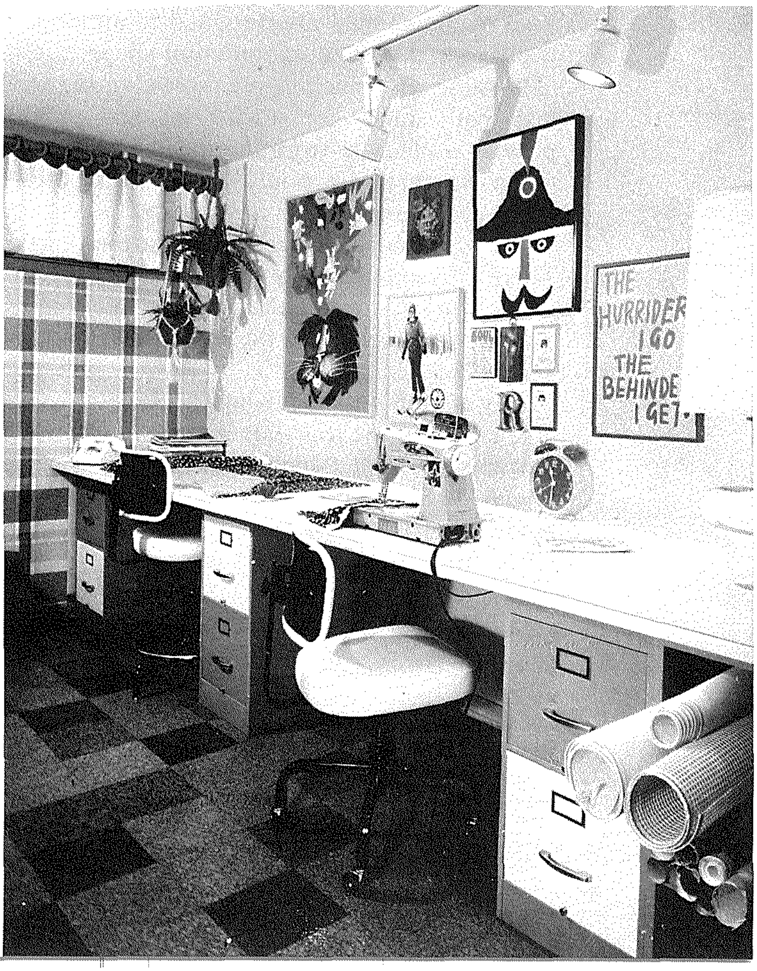
THIS SEWING built-in was once a spare bedroom closet. The machine counter should be 30 in. high to leave a kneehole. Shelves in the back hold sewing supplies and folding doors close to hide everything.



SEE ALSO

Closets . . . Hampers . . . Hobby centers . . .
Laundry counters . . . Modular furniture . . .
Sewing boxes . . . Sewing cabinets . . . Study centers

A QUICKIE to rig is this "built-in." The counter is made of three flush doors and is supported by common metal file cabinets. Kneeholes and chairs provide comfort at each of the sewing stations.



A sewing center for every taste and need

By WAYNE C. LECKEY

Every person who sews has a 'perfect' sewing center in mind. More often than not you will never find one on the market to fit all your needs. Here are four great centers with many interesting and functional features. If you want to go 'all-out' or if you're working with a limited amount of space and money, one of these should fit your needs

▩ LIKE ANY HOBBY, sewing becomes more enjoyable and creates a lot less clutter when you have a work center where there's a place for everything and everything is in one convenient place.

We kept this thought in mind in designing these four highly functional sewing centers. Incorporated in each design you'll find a work counter for pattern cutting, shelves and roomy drawers for keeping fabrics, yarns and patterns handy and trays for pins, needles and threads. Two of the centers are designed to attach to a wall; all fold up in a minimum of space.

Most sewing-machine stands we've seen are just that—stands for sewing machines. They provide a place to store the machine when it's not in use and that's about all. Few, if any, offer a good-size worktable to spread out a pattern. There's little space to keep dress patterns handy. There's no space to stow your sewing and often a lack of tray space to hold countless little items. We've tried to give you these features that most stands lack.

Any portable-type sewing machine is adaptable to any of the four centers shown here. The machine shown in the photos is Singer's Golden *Touch & Sew*, and the counter cutouts were made to fit its particular base. While a cutout allows the machine to sit flush, this can be optional; the machine can simply sit on top of the counter. Plans and instructions for building all four of these sewing centers are shown on the following pages.

SEE ALSO

Cabinet furniture . . . Desks . . . Frames, art . . .
Hobby centers . . . Laminates, plastic . . .
Modular furniture . . . Sewing boxes . . .
Sewing cabinets . . . Study centers

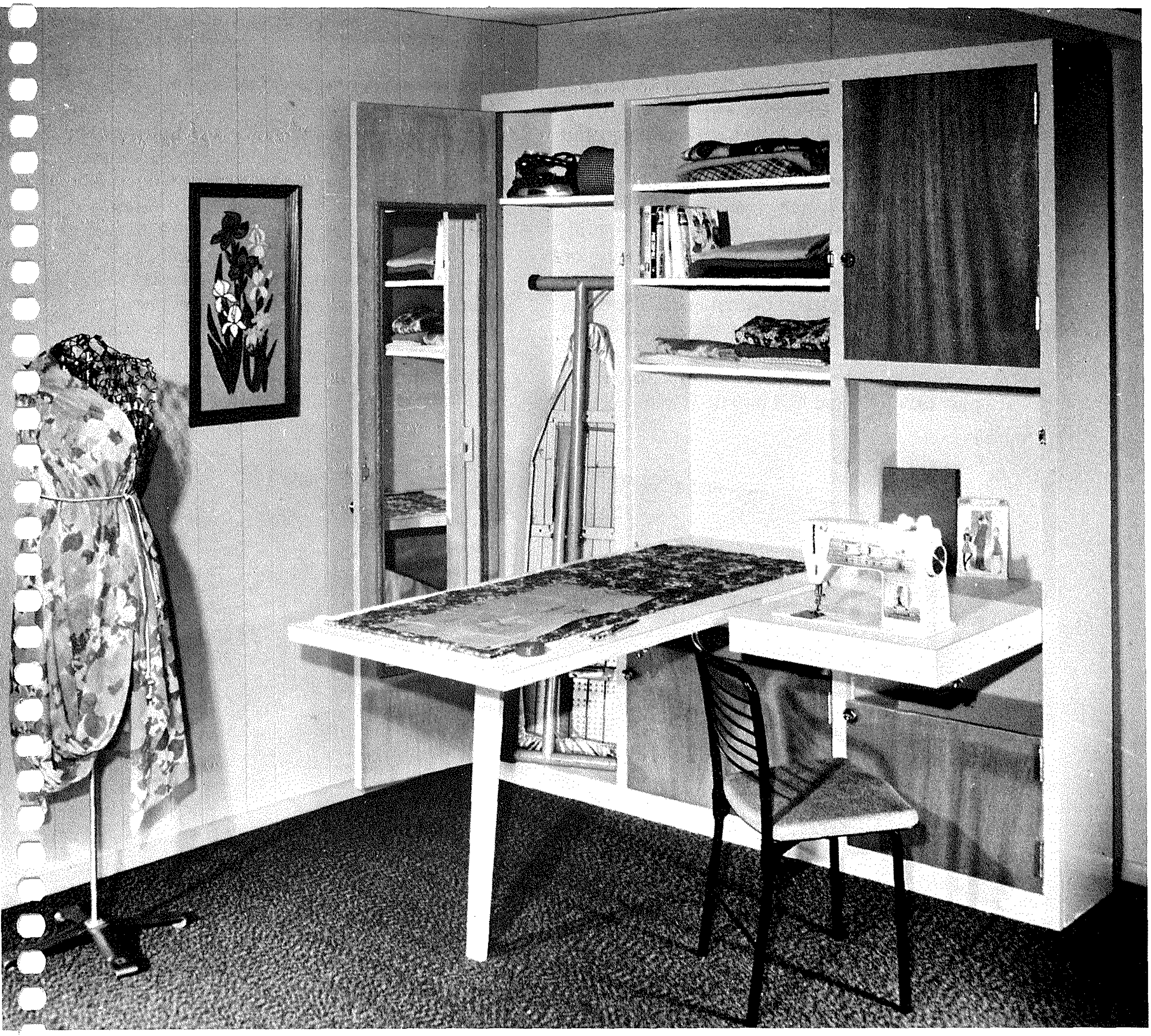
The high-rise unit

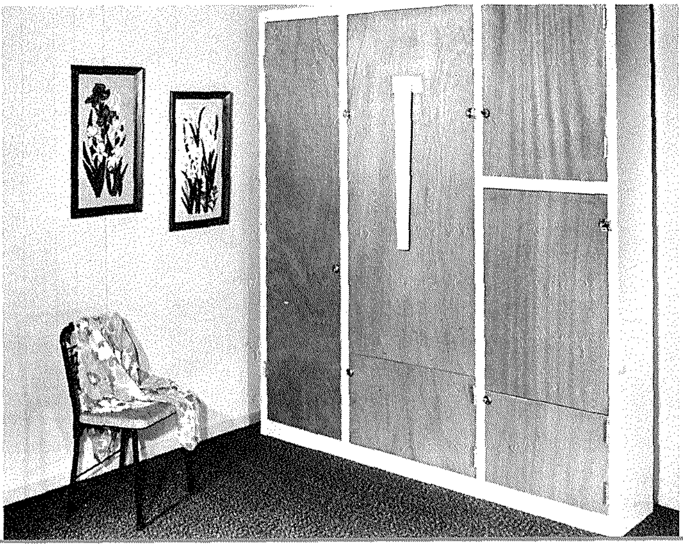
▩ EMPHASIZING convenience, this sewing center is built around three 1⅜-in. flush doors, one left intact and the others cut into sections. The boxlike case to which they are hinged and pivoted is divided into three compartments.

To make the case, cut two side members 13¼ x 84¾ in., then cut a ⅜ x ¾-in. rabbet in the top edges and ⅜ x ¾-in. dadoes 2¼ in. up from the bottom. The rabbets are for a 13 x 76-in. top member; the dadoes for a 13 x 76-in. bottom member. A ¼-in. plywood back laps the edges of top and bottom members, but fits in rabbets cut in the edges of the two side members. The two partitions, 13 x 81 in., are nailed in place through top and bottom members. The left partition is positioned 25¼ in. from the outside; the right one, 23¼ in.

Front edges of the case are faced with 1⅛ x 1½-in. trim pieces of pine, with a 3-in.-wide piece across the bottom. Details B and C in the drawings show how the trim is kept flush with inner faces of the two partitions. Casing nails are used to attach the trim, and the heads are set and puttied.

The left-hand compartment is fitted with a stock 22x80-in. flush door hinged with regular 3-in. door butts. The opening as dimensioned provides ⅛-in. door clearance all around. A rab-





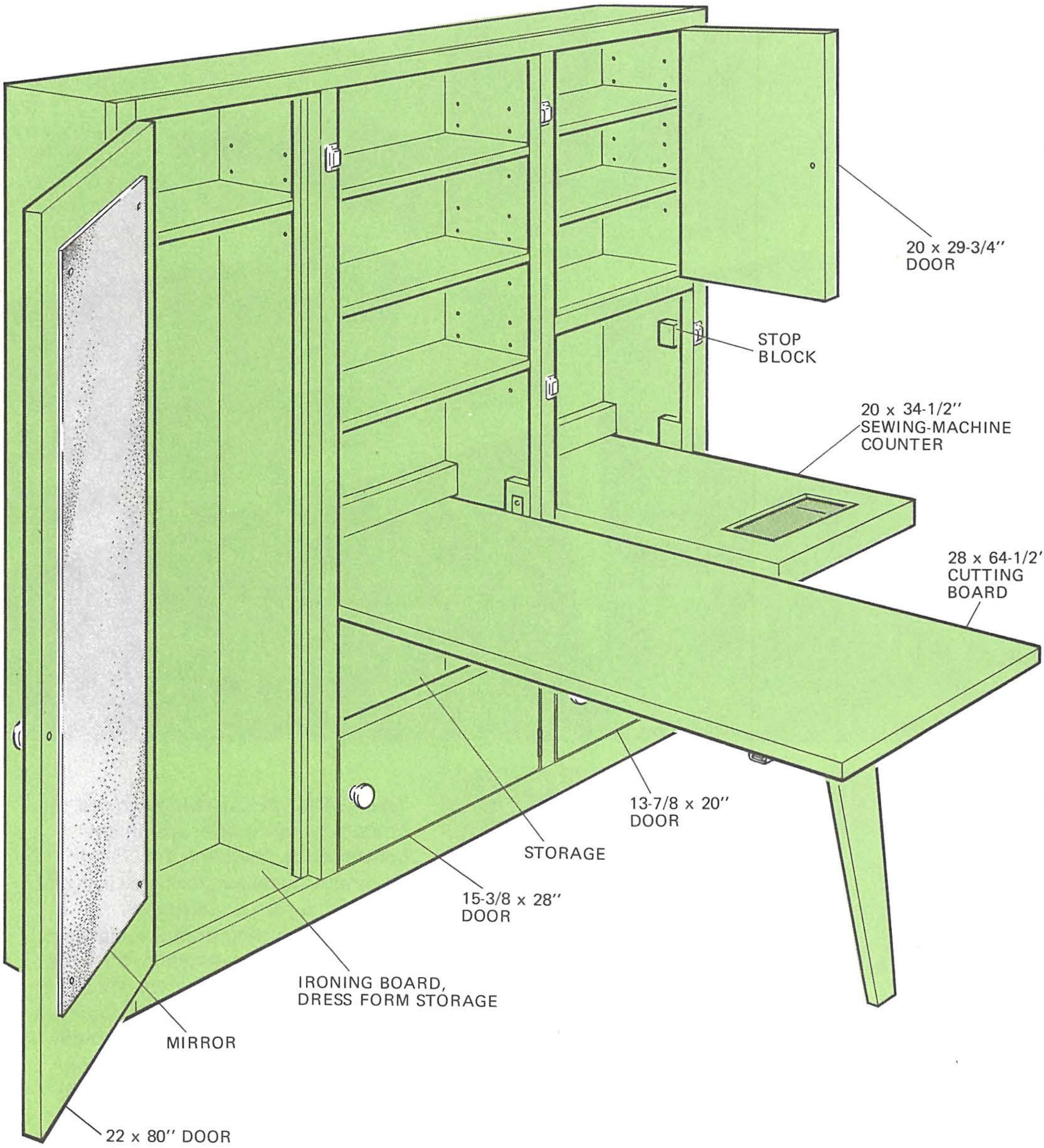
THE ULTIMATE in sewing centers, this one opens up to offer maximum convenience. Standing 7 ft. tall, it features a closet for storing an iron and ironing board, a swing-down 28x64½-in. cutting board, a leg-free, pull-down sewing machine, a mirror door and more storage than you'll ever need. Three common interior doors are used for the front; the rest is chiefly plywood. When tipped on side, the cabinet will easily pass through any standard-height doorway.

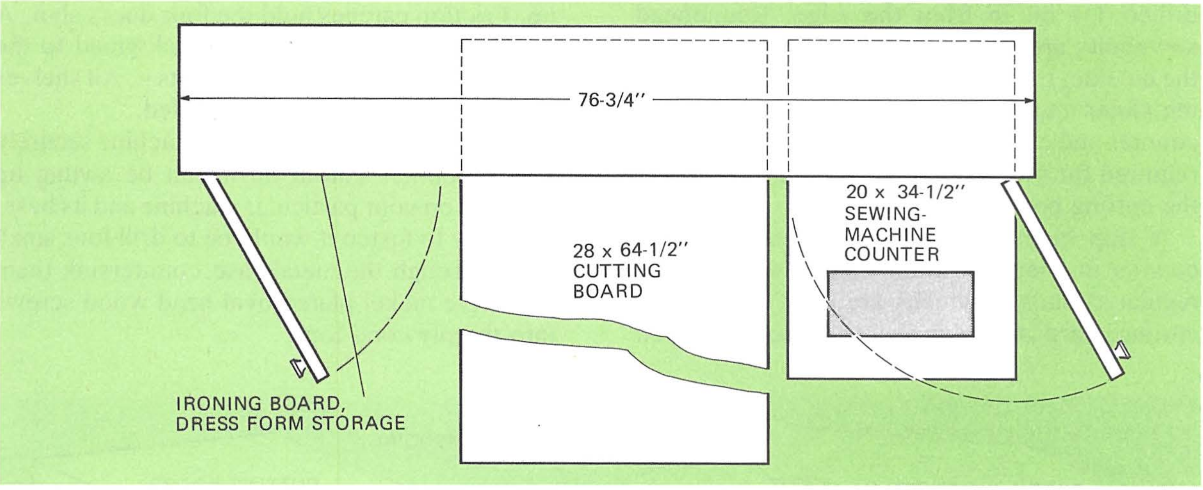
beted stop is on the full length of the door (see detail B); similar stops are on both right-hand doors; the upper stop being 29¾ in. long, the lower one 13⅞ in. The upper right compartment has a ¾-in. bottom 31½ in. down from the top, and a 1½-in. trim piece covers the edge.

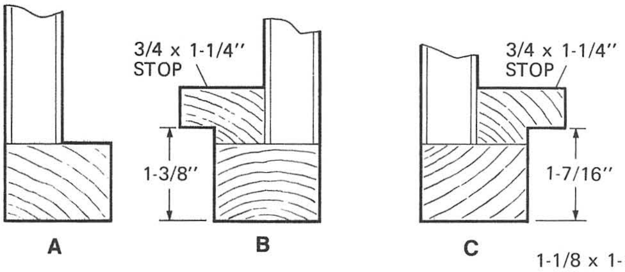
The 28-in. center door is cut in two sections at a point 64½ in. from one end. Since interior doors are hollow, filler strips of solid wood must be inserted and glued in the cut ends. The 64½-in. section is the cutting board and is covered on the back with plastic laminate.

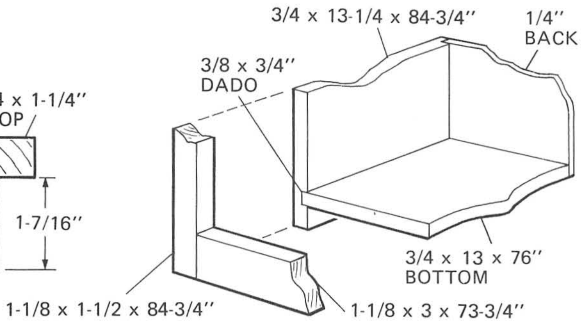
The 20-in. right-hand door is cut in three sections: 29¾, 34½ and 13⅞ in. The 34½-in. section is a swing-up sewing-machine counter. To provide a well for the base of the machine, the counter must be double-thick as shown in the detail, after which the top surface and the three exposed edges of the sandwich are covered with plastic laminate.

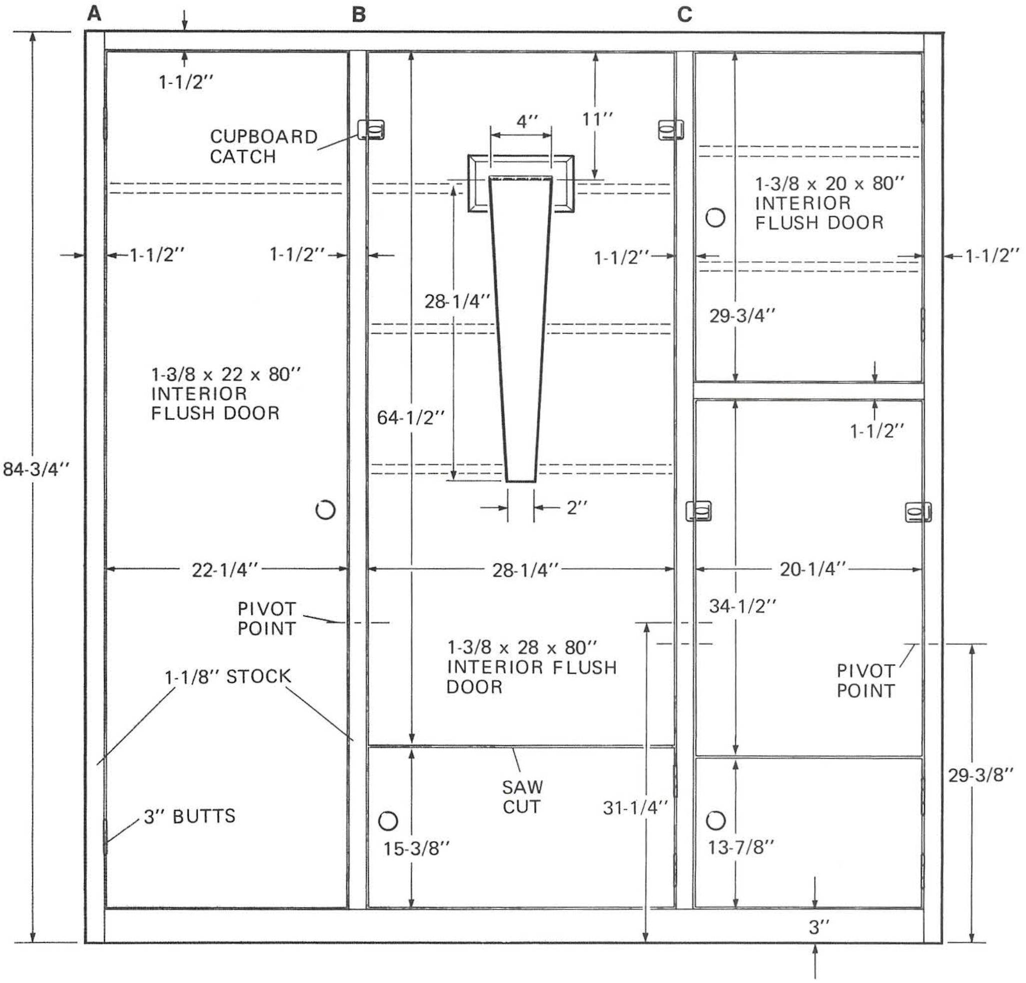
Modified mending plates and ¼-20 T-nuts are used to pivot the cutting board and machine counter. As shown, the plates are attached to the edges, 12½ in. from the far end in the case of the cutting board, 12⅞ in. for the counter. T-nuts are installed in 5/16-in. holes in the cabinet at points 29⅜ in. up from the bottom for the counter and 31¼ for the cutting table. Both sets of holes are


20 x 29-3/4" DOOR
STOP BLOCK
20 x 34-1/2" SEWING-MACHINE COUNTER
28 x 64-1/2" CUTTING BOARD
13-7/8 x 20" DOOR
STORAGE
15-3/8 x 28" DOOR
IRONING BOARD, DRESS FORM STORAGE
MIRROR
22 x 80" DOOR


76-3/4″
20 x 34-1/2″
SEWING-
MACHINE
COUNTER
28 x 64-1/2″
CUTTING
BOARD
IRONING BOARD,
DRESS FORM STORAGE


3/4 x 1-1/4″
STOP
1-3/8″
3/4 x 1-1/4″
STOP
1-7/16″
A
B
C

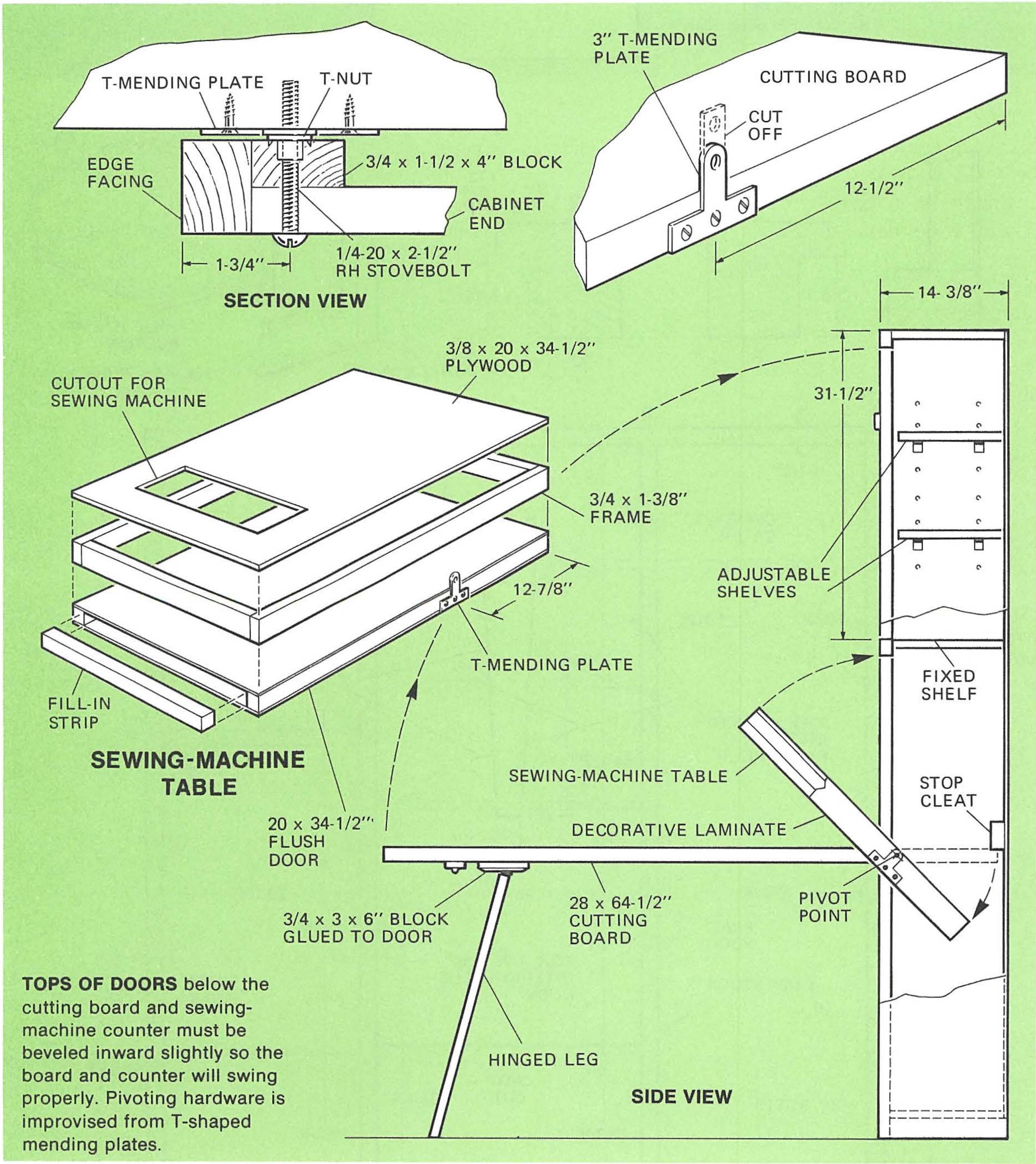

3/4 x 13-1/4 x 84-3/4″
1/4″
BACK
3/8 x 3/4″
DADO
3/4 x 13 x 76″
BOTTOM
1-1/8 x 1-1/2 x 84-3/4″
1-1/8 x 3 x 73-3/4″


A
B
C
1-1/2″
CUPBOARD
CATCH
4″
11″
1-3/8 x 20 x 80″
INTERIOR
FLUSH DOOR
1-1/2″
1-1/2″
1-1/2″
1-1/2″
28-1/4″
29-3/4″
1-3/8 x 22 x 80″
INTERIOR
FLUSH DOOR
64-1/2″
1-1/2″
84-3/4″
2″
22-1/4″
28-1/4″
20-1/4″
PIVOT
POINT
34-1/2″
1-3/8 x 28 x 80″
INTERIOR FLUSH
DOOR
PIVOT
POINT
1-1/8″ STOCK
29-3/8″
SAW
CUT
31-1/4″
3″ BUTTS
15-3/8″
13-7/8″
3″

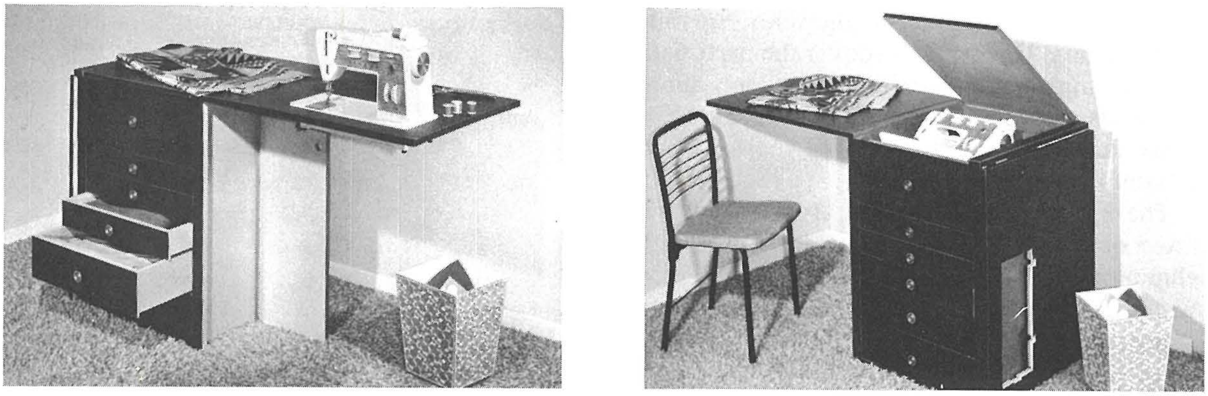
drilled 1¾ in. in from the edge. Roundhead stovebolts are turned through the T-nuts from the outside, through the pivot holes in the mending plates and on into holes in the edges of the counter and cutting board. Bolts 2½ in. long are required for the machine counter, 1 in. long for the cutting board.

A stop block across the back supports the counter in a level position when it's down, and regular cupboard catches are used to hold the cutting board and sewing-machine counter when up. Friction catches hold the four doors shut. A swing-down leg hinged to a block glued to the front of the cutting board supports it. All shelves are adjustable; more can be added.

The method used to hold the machine securely in the counter cutout so it can be swung up depends on your particular machine and its base. One way to fasten it would be to drill four small holes through the metal base; countersink them and drive nickel-plated oval-head wood screws into the plywood top.



TOPS OF DOORS below the cutting board and sewing-machine counter must be beveled inward slightly so the board and counter will swing properly. Pivoting hardware is improvised from T-shaped mending plates.



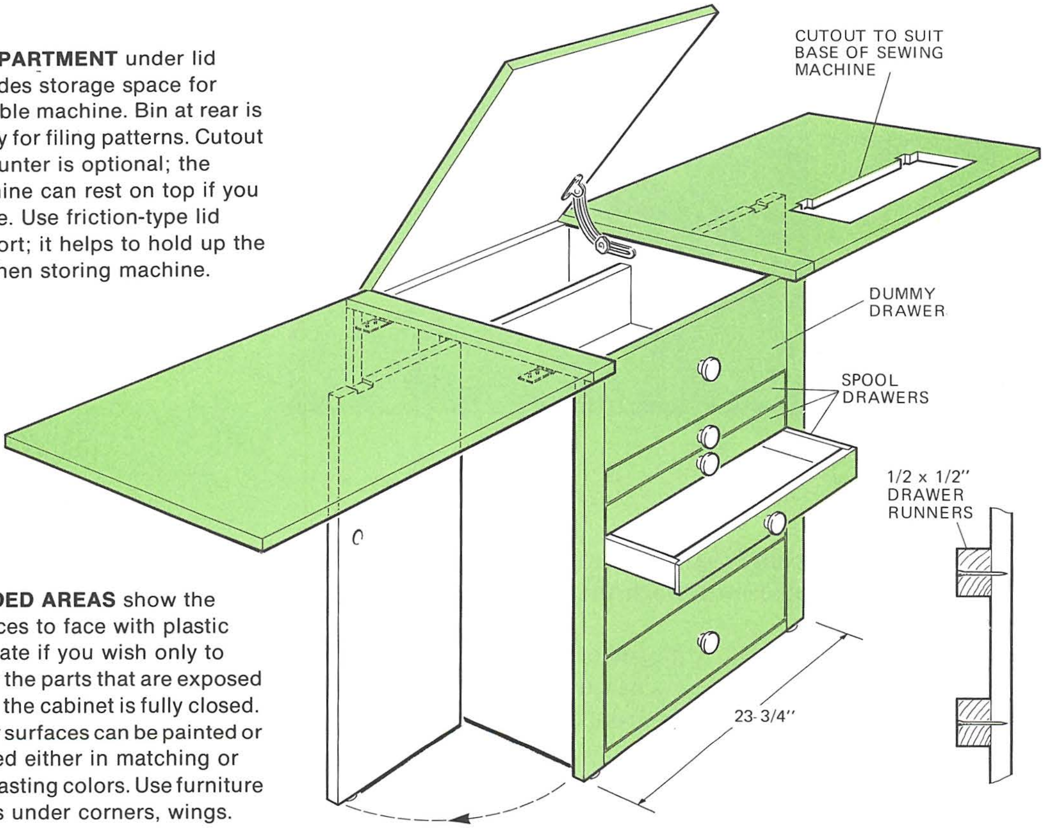
DROP LEAVES on island unit swing up to provide a whopping work surface nearly 84 in. long. Five center drawers offer storage space galore. Sewing machine fits in the cutout, stores in compartment under the hinged lid.

The island unit

■ IN CHECKING the construction details of this work center, you'll see that you can make the sides with ¼ or ¾-in. plywood. Begin by cutting the ¾-in. back panel. It will be 22¾ in. or 23¼ in. wide, depending on the plywood thickness used for the sides. Where ¼-in. plywood is used, run ⅜-in.-deep grooves along the two outer edges of the back ⅞ in. in from the edge. Next cut the two top rails and front pilasters—1⅜ or 1⅝ in., as the case may be—and run similar grooves in them ⅞ in. in from the edge.

A ¾-in.-thick bottom nails to the back panel even with the bottom edge, and a second panel (½ in. thick) is installed 8¼ in. down from the top. The latter is ¾ in. shorter, front to back, than the bottom one. If the sides are ¼ in. thick, the bottom member has to be notched at the front corners to fit around the pilasters and be even with them. You'll notice the two top rails project ½ in. beyond the faces of the pilasters.

Start assembling the parts you have cut, nailing the bottom to the back first, then the ½-in.


CUTOUT TO SUIT BASE OF SEWING MACHINE
DUMMY DRAWER
SPOOL DRAWERS
1/2 x 1/2" DRAWER RUNNERS
23-3/4"

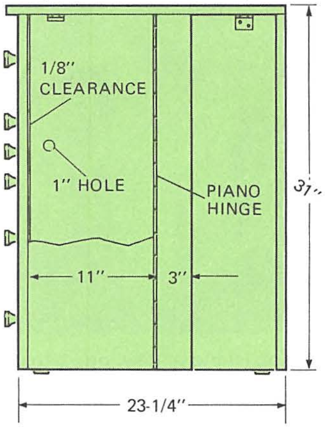
COMPARTMENT under lid provides storage space for portable machine. Bin at rear is handy for filing patterns. Cutout in counter is optional; the machine can rest on top if you desire. Use friction-type lid support; it helps to hold up the lid when storing machine.

SHADED AREAS show the surfaces to face with plastic laminate if you wish only to cover the parts that are exposed when the cabinet is fully closed. Other surfaces can be painted or stained either in matching or contrasting colors. Use furniture glides under corners, wings.

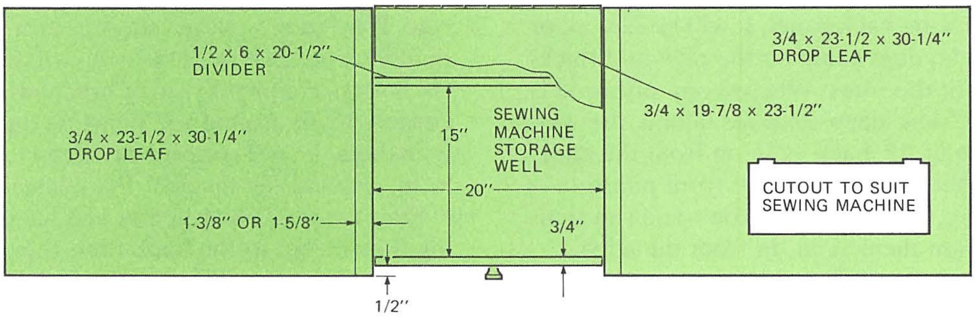
bottom, followed in order by the sides, top rails and pilasters. If you plan to cover the parts with plastic laminate, you won't have to worry about nailheads showing. If not, you'll have to set and putty the nails that show in the top rails and pilasters.

The 8¾-in. dummy drawer front is cut and fitted next. Notice that it is held in place with glue blocks on the inside, and that it fits even with the bottom member. We found it easier to apply the plastic laminate to the face of it before gluing it in place. Notice how the laminate (see section B-B) is cut back 1/16 in. at each end to simulate normal drawer clearance. A 6-in.-wide partition, either 20 or 20½ in. long, as the case may be, is installed in the machine compartment 15 in. from the front and nailed in through the sides.

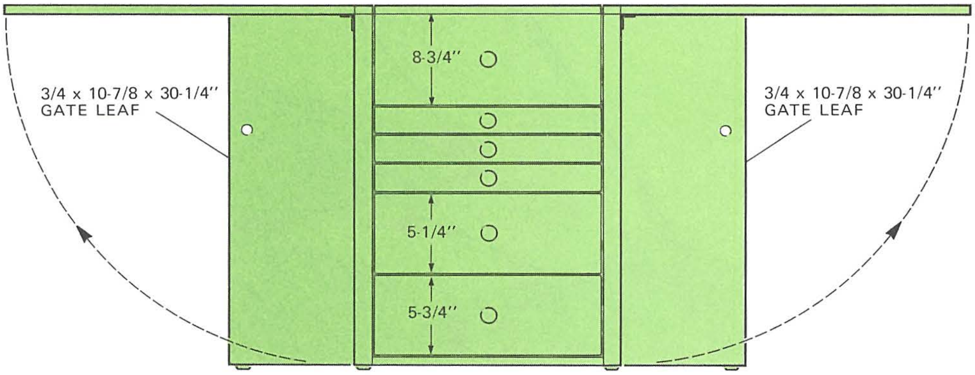
END VIEW
(DROP LEAF REMOVED)



TOP VIEW

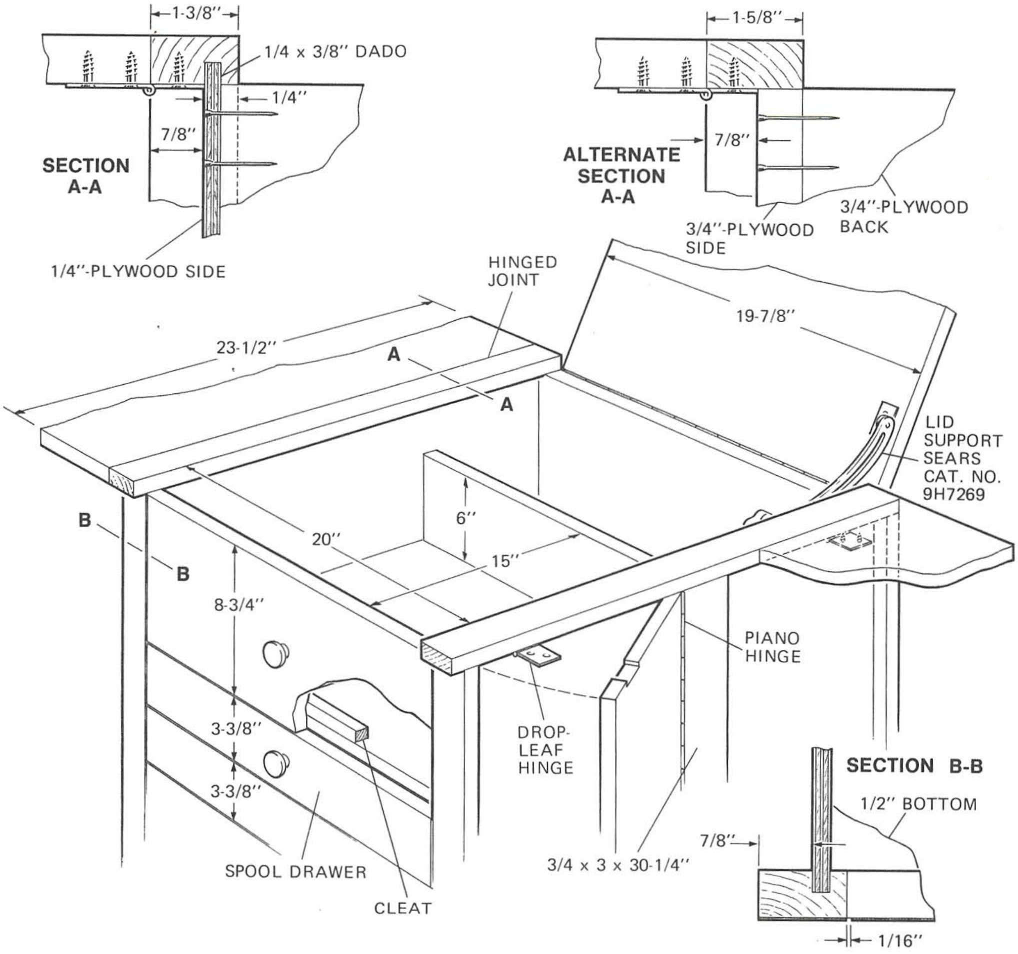


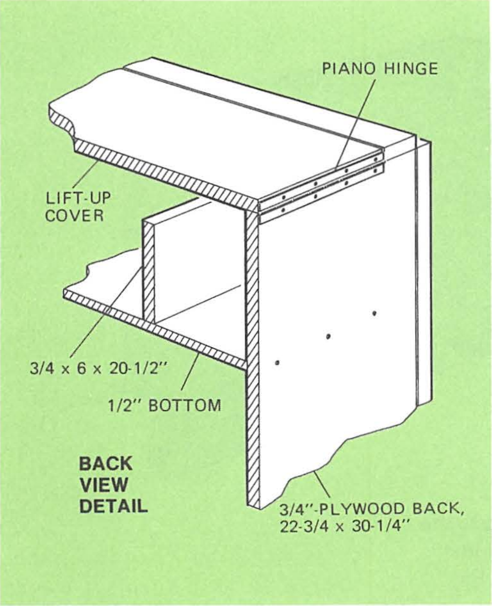
FRONT VIEW



Supporting wings for drop leaves are hinged to ¾ x 3-in. vertical members, added to recessed sides of the cabinet 11 in. back from the front. Finger holes are made an inch or so in from the front edges of the wings, and a notch is made in the top of each one so that it will clear the front hinges. Allow a ⅛-in. space for clearance at the cabinet front so that the wings will swing out easily.

Cut the hinged top 19⅞ in. wide and use a piano hinge to attach it securely across the back. Complete it with a friction-lid support. Hinge the two drop leaves, then place the cabinet on its back and drive rubber-cushion furniture glides into the four corners and outer ends of the wings.





Cementing plastic laminate

1. Cut your laminate ⅛ in. oversize all around.
2. Surfaces to be bonded must be dry and clean.
3. Apply even coat of contact cement to both laminate and wood, using brush or spreader.
4. Let both surfaces dry before bonding (10-20 minutes normally). Surfaces will bond when adhesive will adhere but not transfer to brown wrapping paper if touched lightly. If cement becomes too dry (over 3 hours), apply another coat.
5. Bring surfaces in contact *exactly* where desired (cement bonds instantly on contact, so you can't shift the work later). Two overlapping pieces of kraft paper placed over cement will let you position the laminate without sticking. When laminate is where you want it, pull out one paper, press down the plastic, then pull out second paper.
6. Using rubber mallet or hammer and wood block, apply pressure all over surface for positive contact.
7. Trim laminate flush with work; use block plane and flat file or router and special laminate cutter.
8. Clean tools, brushes with contact-cement solvent.

The dual unit

■ SIMPLEST TO MAKE of the four sewing centers is a dual-unit center that appeals to the builder who wants to spend a minimum of time and money. Of its two individual units, one is attached to the wall to accommodate a portable sewing machine and the other is placed alongside. Together they offer the sewer convenience and storage galore.

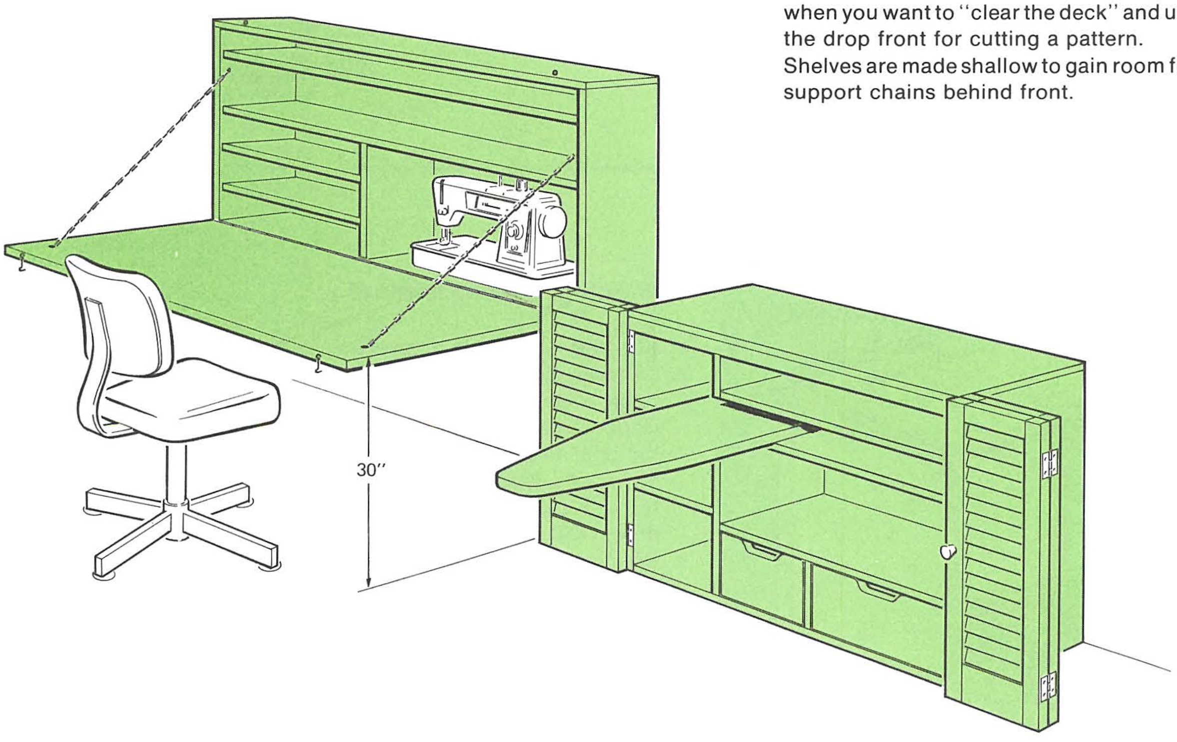
Little more than a box fitted with a back and shelves, the drop-counter wall unit is practically a hammer and saw project. The ends and the top and bottom members are cut in pairs as are the four shelves. The top and bottom boards lap the end members, and the two long shelves butt between. To gain "headroom" for nailing the short divider in place, you should install the lower long shelf first, then the two short shelves and finally the upper one. Chains support the drop front; hooks and eyes hold it shut. Two 3-in. angle brackets across the top and bottom anchor the unit solidly to wall studs.

Although the base unit is twice as deep as the wall unit, construction is much the same. The top and bottom members lap the end members, and a divider forms compartments. One difference you'll notice in basic construction is the 1½-in. apron that's let in across the front at the top. This requires ¾ x 1½-in. notches cut before assembly.

The sit-down ironing board pivots on a single carriage bolt that passes through a hole in the second shelf and swings clear of the end when not in use. Two drawers with handholds are made to slide easily in the 12 and 22½-in. openings. Stock cabinet louvers are used for doors and trimmed to fit. They're hinged to fold, and held shut by magnetic catches.

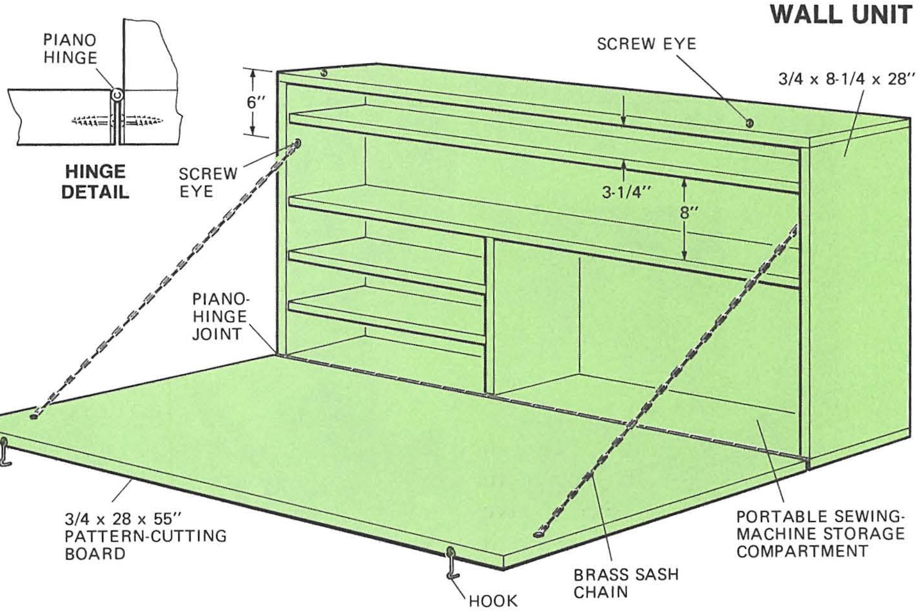
The wall unit should be hung so that the drop front will level at about table height (30 in.) when open.

SEPARATE COMPARTMENT for the sewing machine provides a place to put it when you want to "clear the deck" and use the drop front for cutting a pattern. Shelves are made shallow to gain room for support chains behind front.

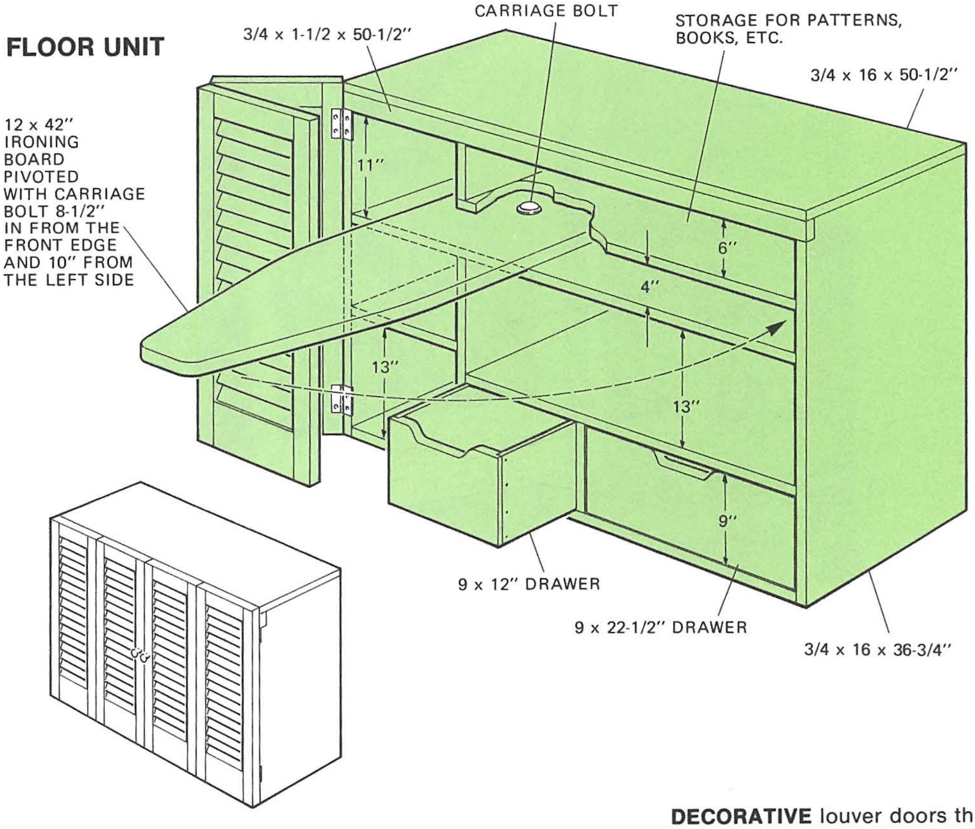


FURNITURE GLIDES attached to the four corners will raise the cabinet enough to provide clearance for the louver doors.

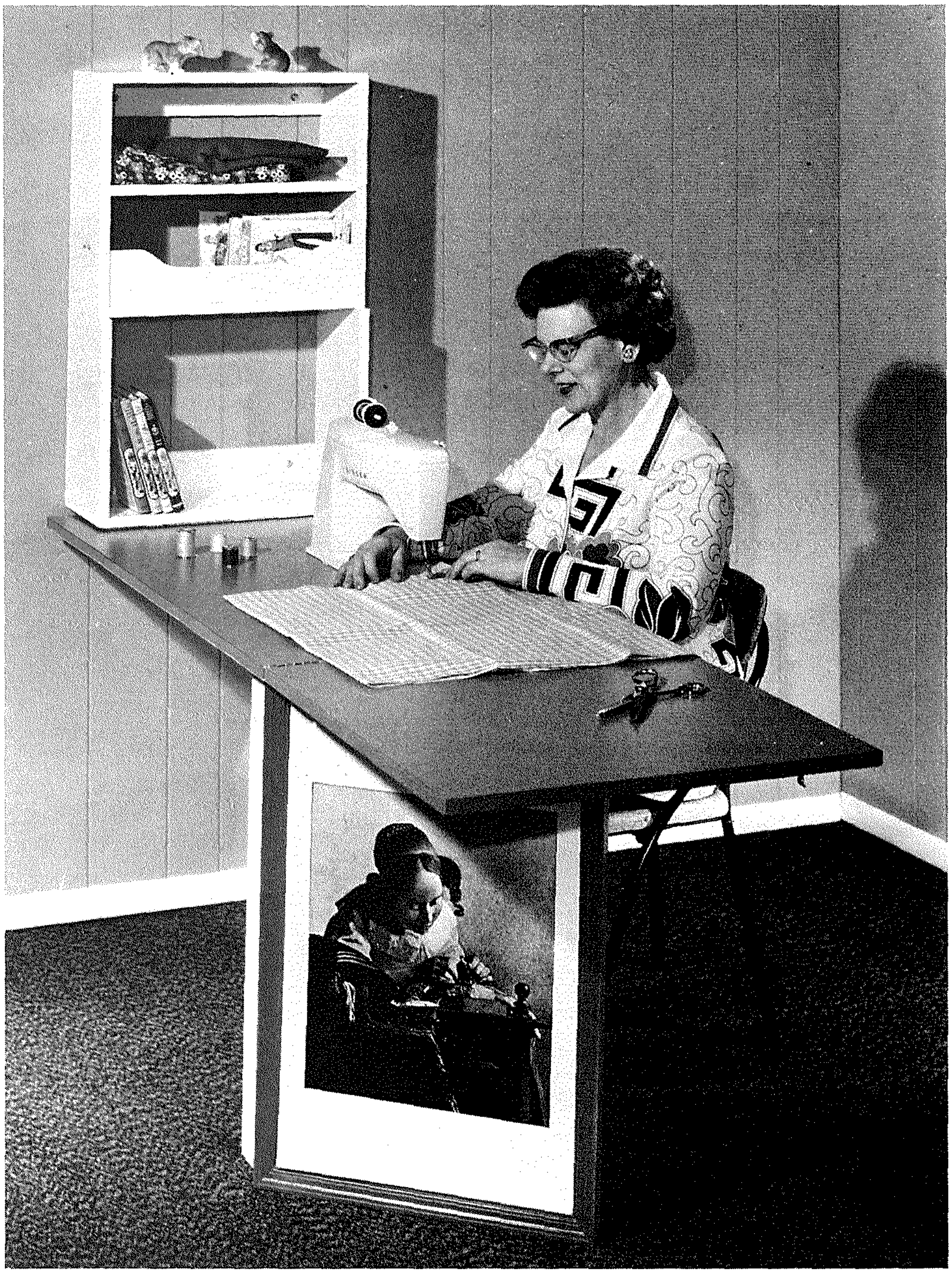
WALL UNIT



FLOOR UNIT


CARRIAGE BOLT
3/4 x 1-1/2 x 50-1/2"
STORAGE FOR PATTERNS, BOOKS, ETC.
3/4 x 16 x 50-1/2"
12 x 42" IRONING BOARD PIVOTED WITH CARRIAGE BOLT 8-1/2" IN FROM THE FRONT EDGE AND 10" FROM THE LEFT SIDE
11"
6"
4"
13"
13"
9"
9 x 12" DRAWER
9 x 22-1/2" DRAWER
3/4 x 16 x 36-3/4"

DECORATIVE louver doors that are hinged to bifold provide an attractive front to the base cabinet and permit full access when open.



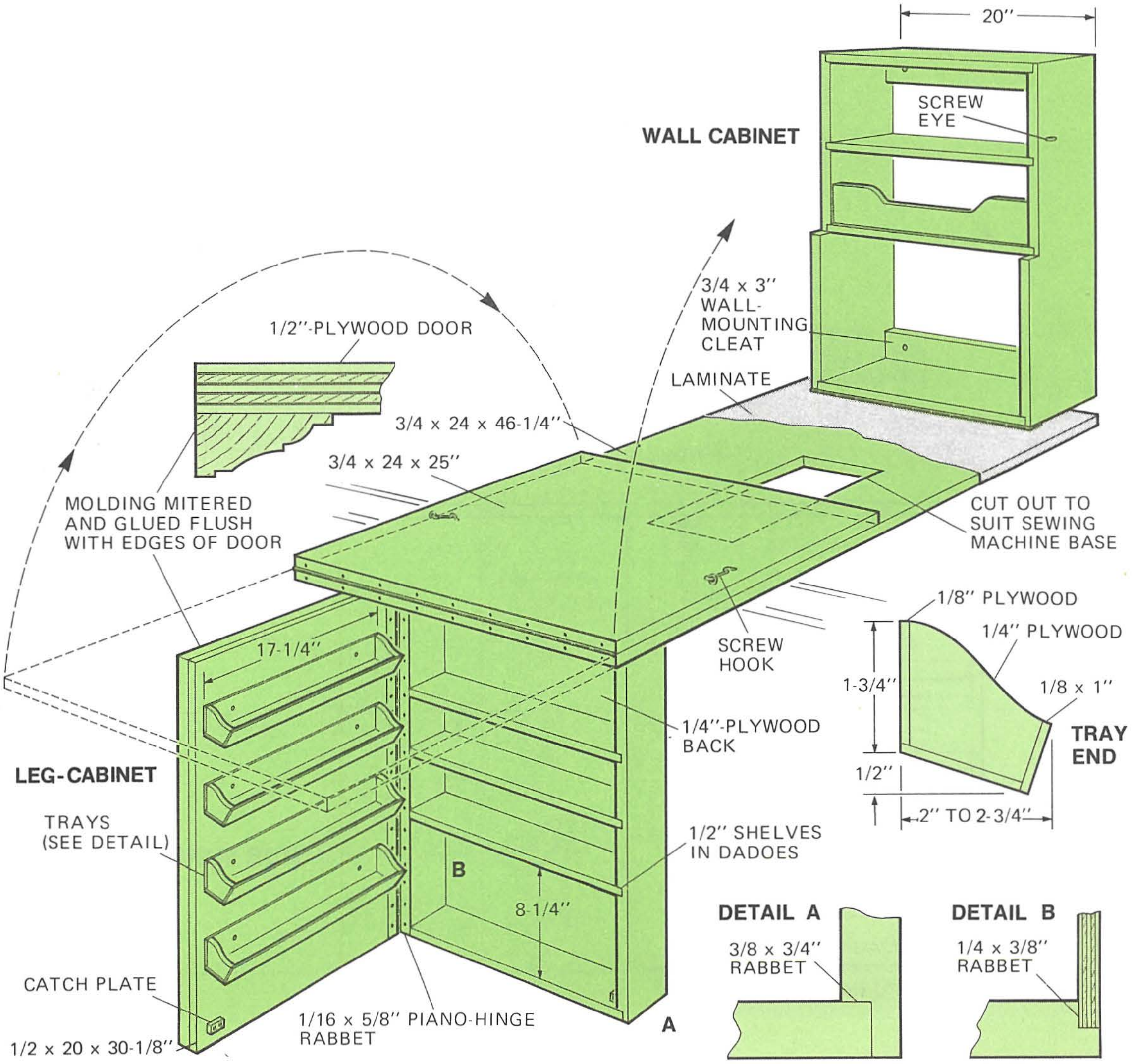
THIS SEWING CENTER, when open, extends to a king-size, 20x65-in. work counter. When swung up out of the way it is cleverly hidden behind a decorative wall plaque of your choice.

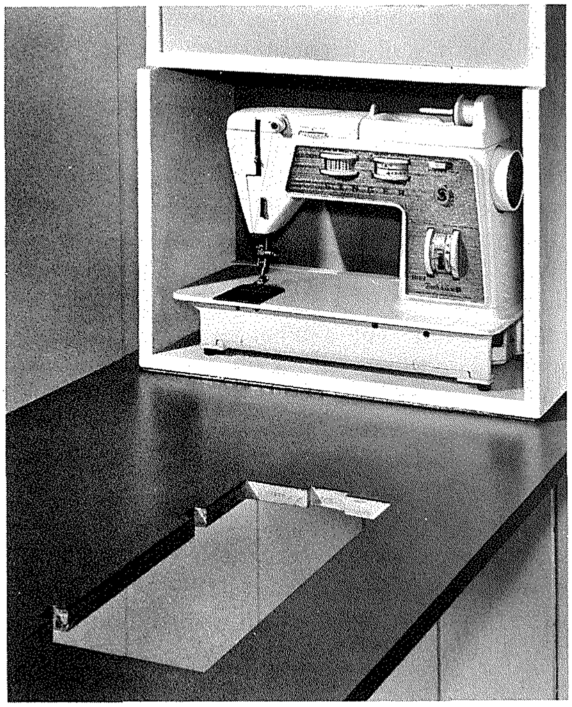
The dual-role unit

▨ WHERE SPACE is limited and there just isn't room to have a sewing center in the way all the time, this one retracts against the wall to serve as a decorative plaque. When stored, it projects only 14 in. from the wall, leaving free floor space under it. Even when the sewing center is retracted you still can get at thread and other small items.

There are three parts: a cabinet bolted securely to a wall, a counter and cutting board hinged to the cabinet, and a swing-down cabinet-leg hinged to the outboard end of the cutting board for support. The leg has a picture-frame door that swings open to support a flip-over extension. When fully open, the cutting board measures some 65 in. long and 24 in. wide. The wall cabinet provides storage for the machine, and shelves above for sewing, patterns and what not. The cabinet-leg has shelves for odds and ends, and the back of the door has four handy trays for thread, buttons, thimbles and the like. The door front is made to look like a framed picture. Hooks and eyes keep the whole thing stored against the wall. When in use, the sewing machine is flush in a cutout in the cutting board.

Except for the two mounting cleats, the back of the wall cabinet is open. Each side is 9 x 32½ in. and is rabbeted top and bottom for 8 and 9-in.-wide members 19¼ in. long. Two 8-in.-wide shelves fit between in dadoes, the bottom one being placed 17 in. down from the top and even with the notched cutback.

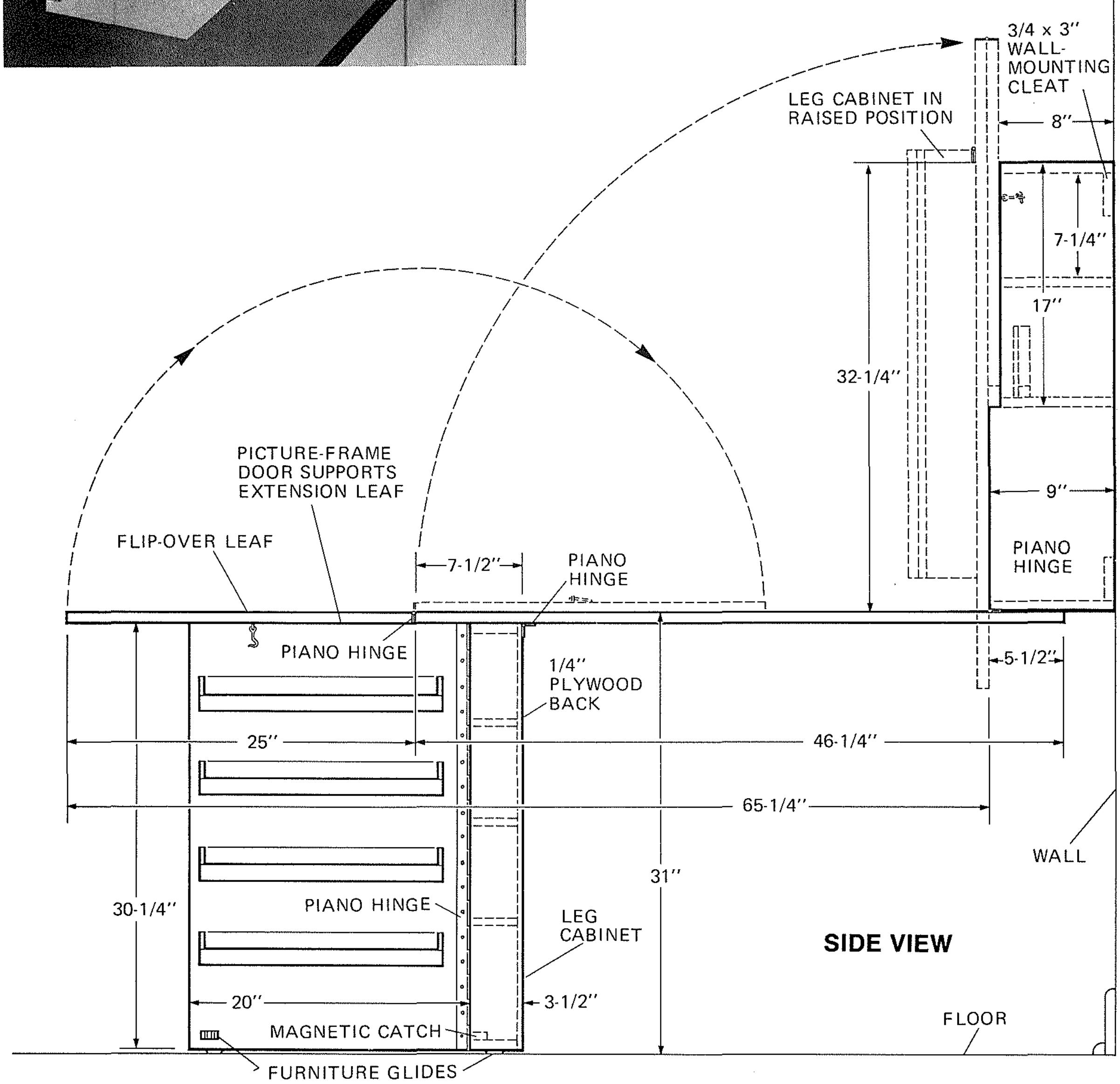


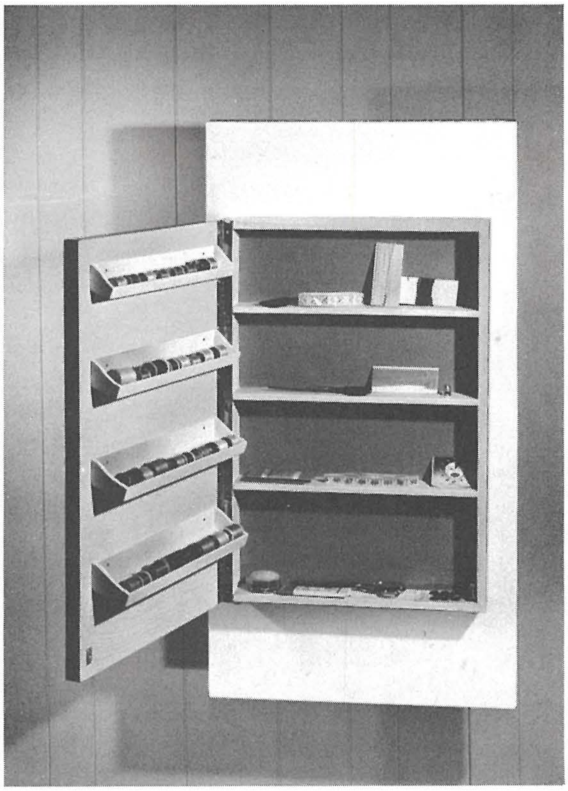


The cabinet-leg, 20 in. wide and 30¼ in. high, is made from 1x4 pine. Edges are rabbeted for a ¼-in. plywood back, side members are dadoed for ½-in. shelves, and 19¼-in. top and bottom members are housed in ⅜-in.-deep rabbets. The ½-in. plywood-panel door has a mitered frame of lumberyard molding glued to the front. Mat and picture are framed by simply gluing them to the plywood with rubber cement. Choose a painting or photograph which will look best if it is standing out a distance from the wall.

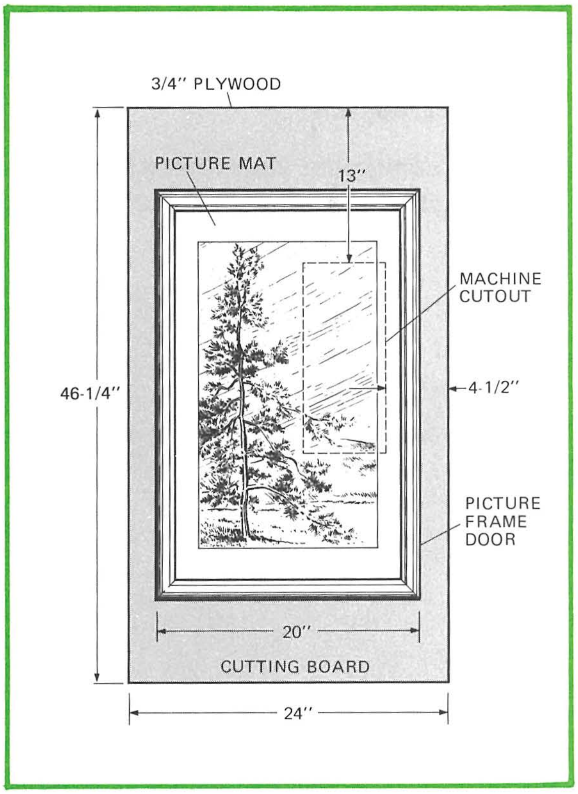
The framed door is attached with a piano hinge set in 1/16-in.-deep rabbets in both door and cabinet so there is no gap between the two when closed. The four spool trays vary in depth from 2 to 2¾ in., with bottom tray being the deepest. Ends are cut from ¼-in. wood, the rest from ⅛

SEWING MACHINE stows in base of open wall-hung cabinet when the sewer calls it a day and closes up shop.



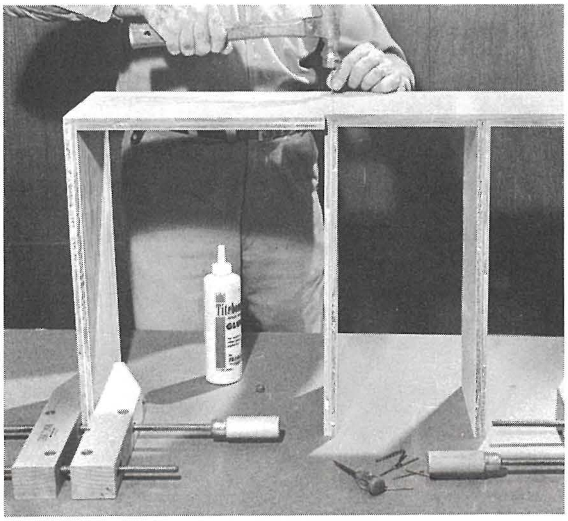


HINGED PICTURE FRAME provides access to thread and other items, even when the sewing center is stored.

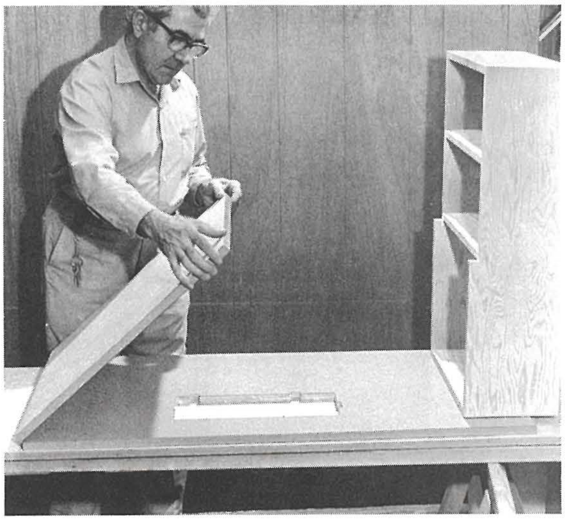


in. Each tray is fastened to the door, after painting, with small oval-head wood screws.

We banded the edges of the cutting board first with plastic laminate, then covered the top surface, before hinging the extension to the end with a 20-in. piano hinge. To assure that the extension aligns properly with the cutting board when it lies back on top of it, hold them with two C-clamps while you hinge them together. As shown in side-view drawing, the hinge point for the cabinet-leg at the outboard end of the cutting board is 7½ in. It's hinged to the wall cabinet 5½ in. from the end. Paint the cabinet to complement the decor of the room.



PAIR OF WOOD clamps is of great help for holding part of the wall cabinet during the first phase of assembly.

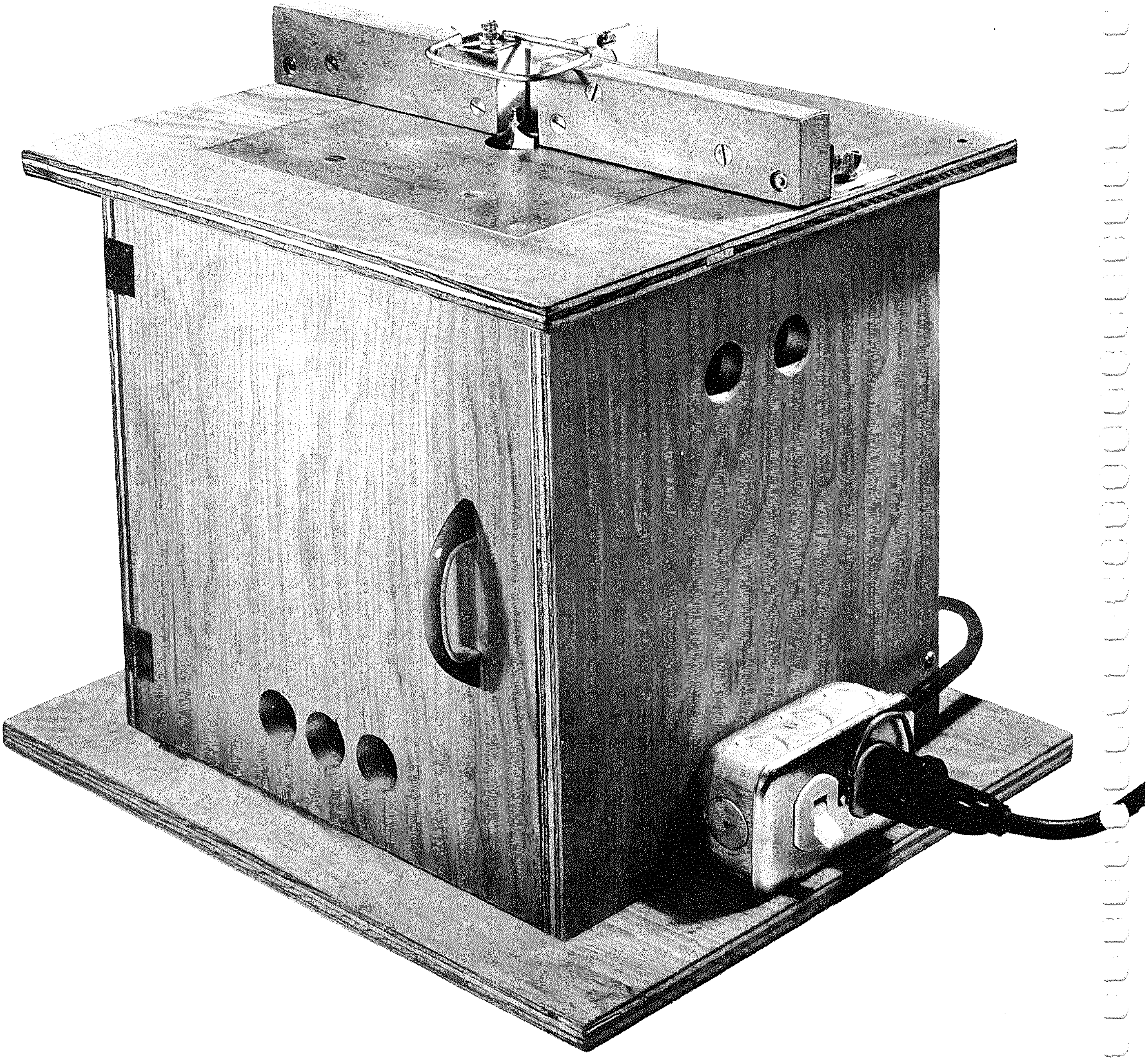


FLIP-OVER EXTENSION should align with edges of cutting board when it lies back on top for storage.

Your router becomes a shaper

By WALTER E. BURTON

Build this cabinet for your router and you'll have an instant shaper for your shop. Here's how to do it



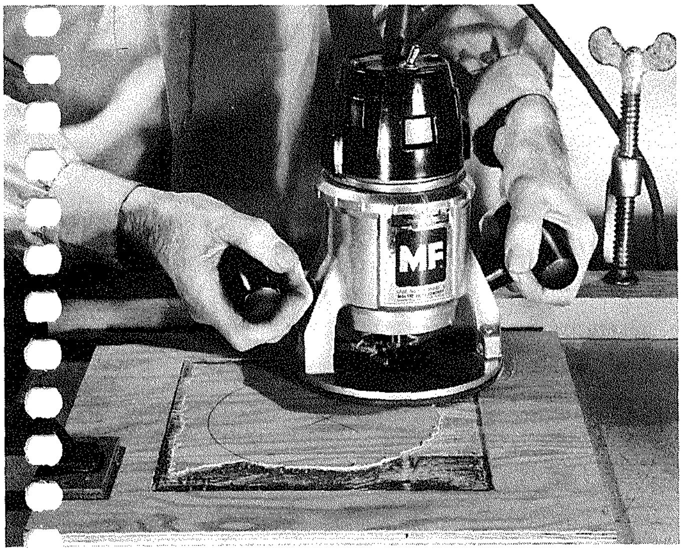
SEE ALSO

Moldings . . . Motors, shop . . . Power-tool stands . . . Routers . . . Routers, accessories . . . Workbenches . . . Workshops

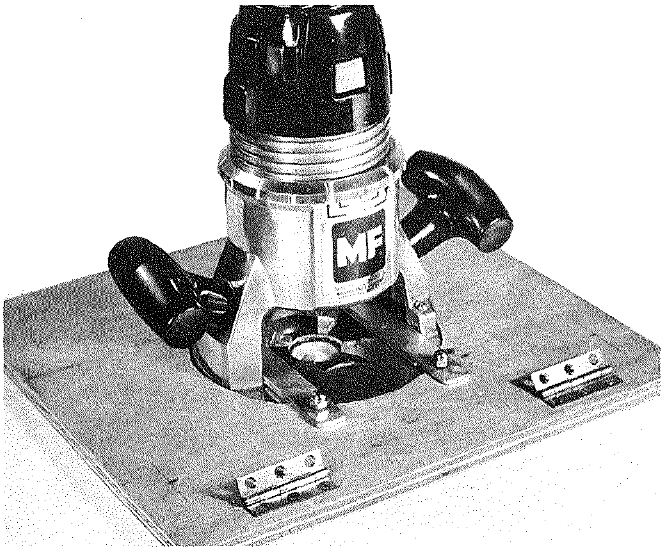
■ IF YOU TURN a portable router upside down, you have, essentially, a wood-working shaper. To do it, the inverted router must be supported in such a way that it can function as a shaper with work guides, guards and the like. This shop-built version was designed to accommodate a Millers Falls MF router, Model A, catalog No. 7200. But, where necessary, dimensions can be altered for your own router.

The router hangs suspended from the underside of the cabinet top so that it can be removed for conventional routing operations by unscrewing four nuts. The hinged top tilts upward for convenience in changing cutters and making adjustments—although you can make cutter-height settings by reaching into the cabinet.

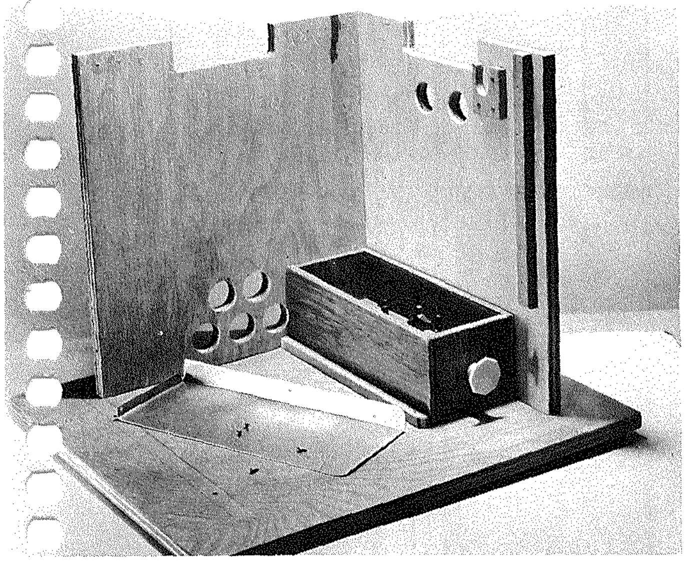
The cabinet top is hinged to the rear panel. Centered on the top is a $\frac{1}{16}$ x 8 x 8-in. aluminum plate that rests in a recess so the plate surface and adjacent wood are in the same plane. The hole at plate center is approximately 1⅛ in. in diameter. In the wood top, concentric with this



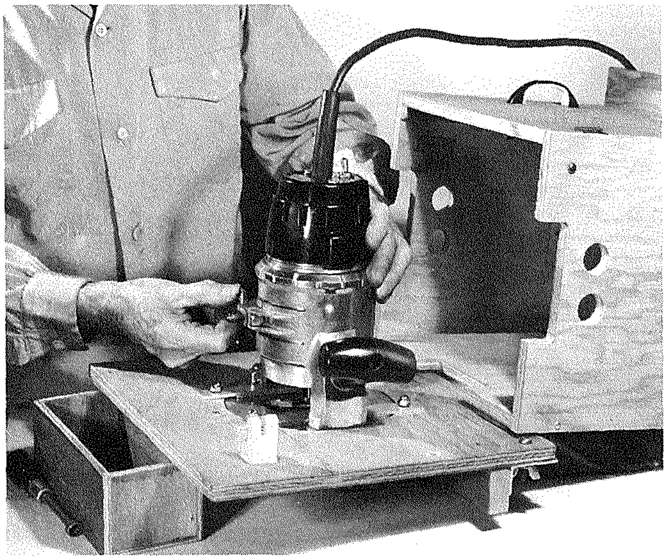
THE ROUTER cuts a recess in cabinet top to hold the plate against which router base is clamped.



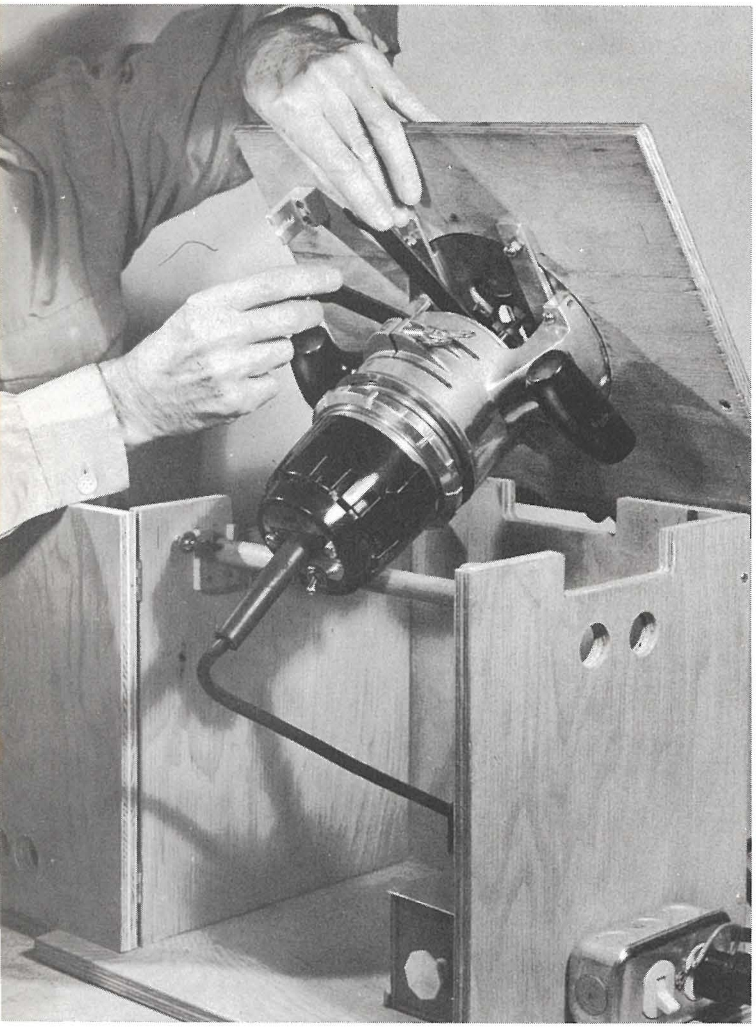
BOTTOM OF the top panel shows the router clamped in place against the metal plate.



IN PARTIALLY assembled cabinet, the accessory drawer and vent openings for airflow are seen.



FOR INSTALLING or removing the router, the cabinet is flipped on its back and top panel swung open.



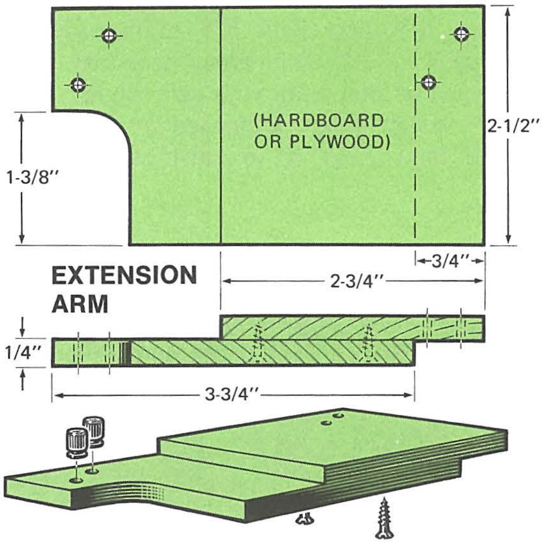
TO CHANGE cutters, the router is swung up and held by a dowel engaging sockets on the side panels.

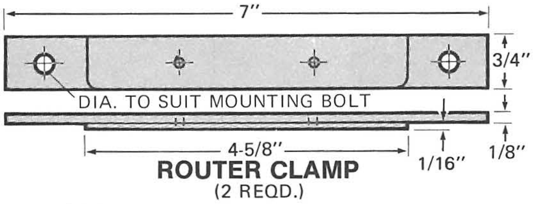
router becomes a shaper, continued

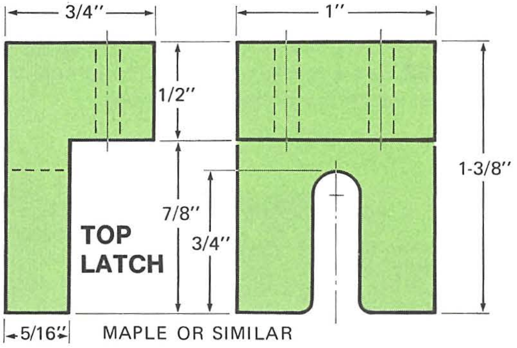
hole, is a 6-in.-dia. opening for the router base. Check your router's shoe diameter before cutting this circle.

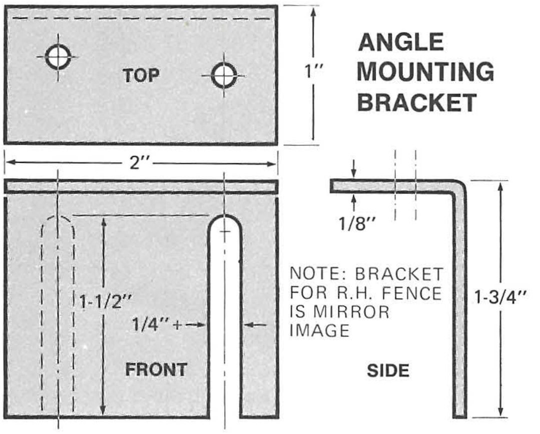
You can form the 1/16-in.-deep recess by routing out most of the area with a straight bit. Leave an "island" in the center until last so the router shoe is supported. Then, remove the island with a router bit in a drill press. Next, jigsaw the 6-in. opening. Fasten the plate in its recess with two countersunk wood screws near the opposite corners.

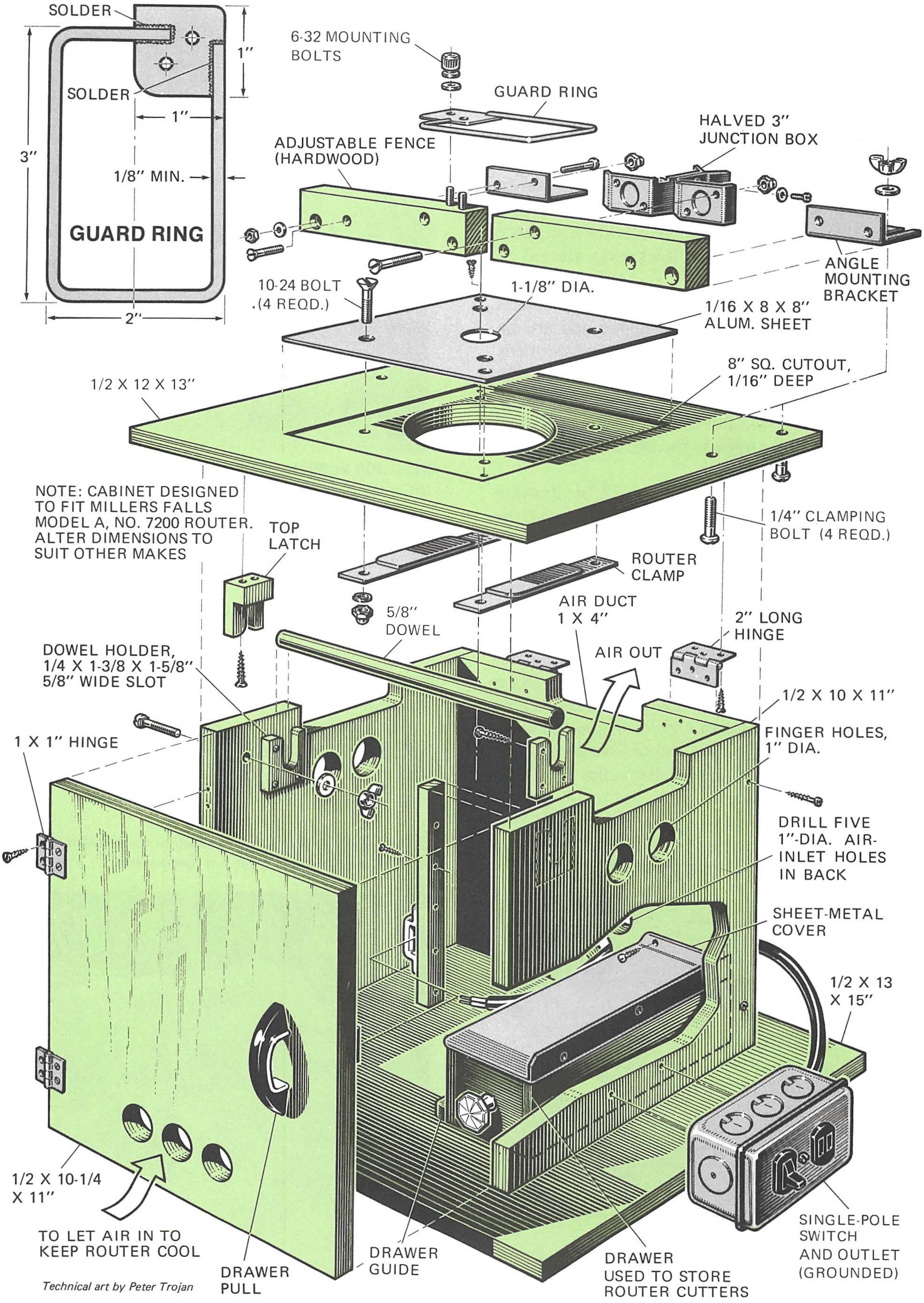
To determine the center of the 1⅛-in. hole, insert a pointed cutter in the router and place the router base into its opening. The point where










SOLDER
SOLDER
1"
1"
3"
1/8" MIN.
GUARD RING
2"
6-32 MOUNTING BOLTS
GUARD RING
HALVED 3" JUNCTION BOX
ADJUSTABLE FENCE (HARDWOOD)
ANGLE MOUNTING BRACKET
10-24 BOLT (4 REQD.)
1-1/8" DIA.
1/16 X 8 X 8" ALUM. SHEET
8" SQ. CUTOUT, 1/16" DEEP
1/2 X 12 X 13"
NOTE: CABINET DESIGNED TO FIT MILLERS FALLS MODEL A, NO. 7200 ROUTER. ALTER DIMENSIONS TO SUIT OTHER MAKES
TOP LATCH
1/4" CLAMPING BOLT (4 REQD.)
ROUTER CLAMP
5/8" DOWEL
AIR DUCT 1 X 4"
2" LONG HINGE
DOWEL HOLDER, 1/4 X 1-3/8 X 1-5/8" 5/8" WIDE SLOT
AIR OUT
1/2 X 10 X 11"
1 X 1" HINGE
FINGER HOLES, 1" DIA.
DRILL FIVE 1"-DIA. AIR-INLET HOLES IN BACK
SHEET-METAL COVER
1/2 X 13 X 15"
1/2 X 10-1/4 X 11"
TO LET AIR IN TO KEEP ROUTER COOL
DRAWER PULL
DRAWER GUIDE
DRAWER USED TO STORE ROUTER CUTTERS
SINGLE-POLE SWITCH AND OUTLET (GROUNDED)

Technical art by Peter Trojan

the bit touches the metal plate is the center for the hole. Use two 2-in. butt hinges to join top to back panel. Although the router's weight will hold the top down, rigidity is increased by installing a simple wooden latch at the corner near the front panel hinge.

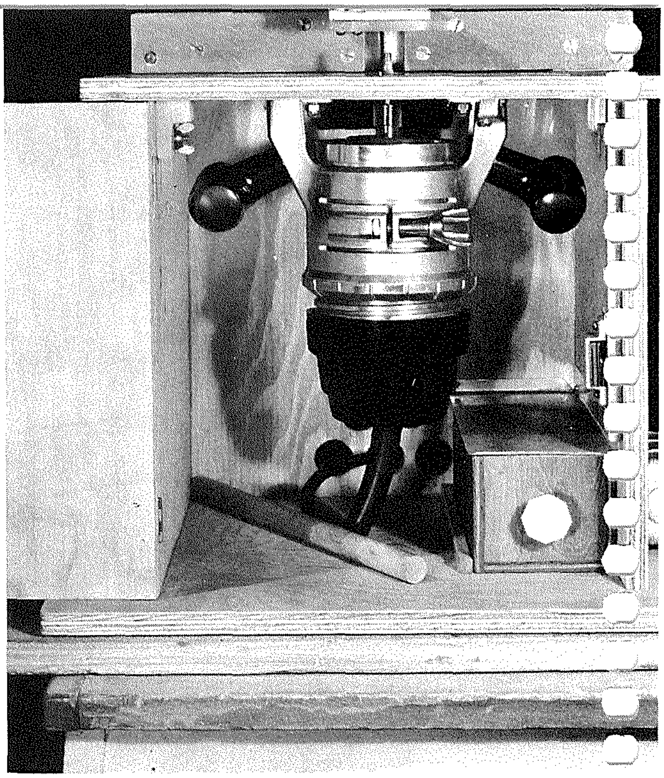
The router-mounting arrangement is dictated by router-base construction. For the tool shown, two ⅛ x ¾ x 7-in. aluminum strips, with $\frac{1}{16}$ x ¾ x 4⅝-in. pads (to compensate for difference in router base and wood thickness) riveted to them, worked fine. Four 10–24 bolts extend through these strips, through countersunk holes in the metal top insert and plywood and are secured to the cabinet top with nuts and washers.

The cabinet and cabinet-top sizes are not critical. The dimensions given provide adequate space, although the power cord must be curved sideways in order to clear the bottom at the usual cutter depth settings.

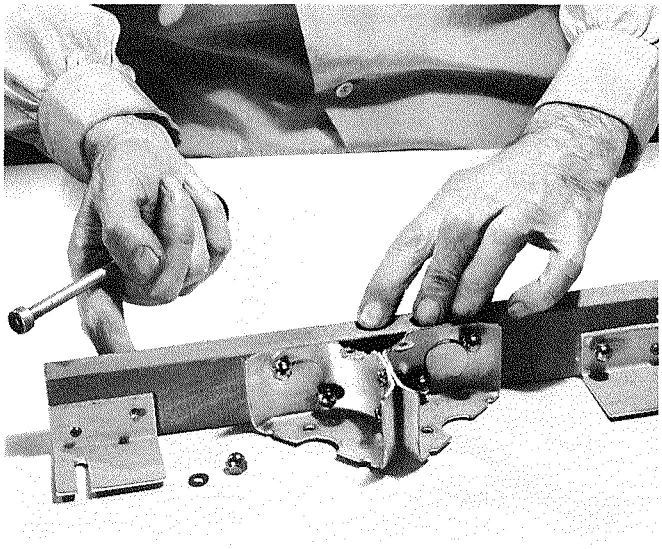
Since a router motor "breathes" by drawing air in at cord-end and discharging it around the cutter, it's a must to provide airflow holes in the box. These consist of 1x4-in. notches at top edges of the sidepieces and back panel and multiple 1-in. holes in the back and front panels. (The two 1-in. holes at the top of each side are primarily finger holes for carrying.) If the intake air seems to carry excessive dust and chips, it's a good idea to install some fine-mesh screen over the inlets. Chips should not be permitted to build up in the box; if the router is to be used for long periods, periodically check the motor to avoid overheating. If necessary, leave the door open.

The hinged top can be raised to give better access to the router when you change cutters. The router is held in the tilted position by resting it on a piece of ⅝-in. dowel whose ends engage notched plywood pieces screwed to the inside surfaces of sidepieces.

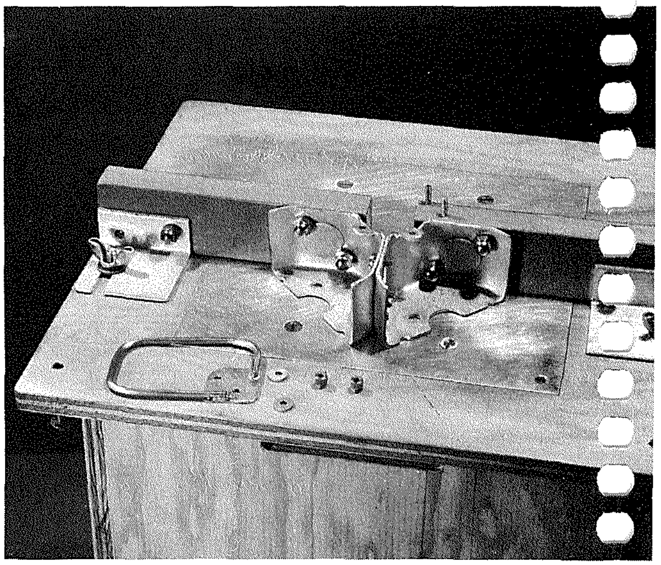
The storage drawer is made of ¼-in. plywood and is located in one corner of the cabinet. To keep it in position, glue a guide strip along the



INTERIOR VIEW shows the router in operating position. Original plastic shield was replaced by the ring type.



MOUNTING clamps and center coupling, made from a halved 3-in. junction box, are attached to fence.



REAR OF guide fence is in position for straight work. Notice the ring-type guard in foreground.

bottom. A sheet-aluminum cover helps keep dirt out and the drawer in place. Inside, a wooden block drilled to receive cutter shanks holds stored cutters.

An adjustable fence guides straightedged work past the cutter. I used a piece of maple cut to the dimensions indicated. An angle mounting bracket was then fastened to each end with bolts.

An adjustable bracket assembly made from a 3-in. electrical junction box (sawed diagonally in two) is bolted to the fence center. A little hammering and filing will let you fit the box halves squarely with the surfaces at a right angle and parallel where they contact the wood. Three 8–32 bolts hold the two halves together; holes in one of them are slotted so the guide fence can be adjusted for cut depth when jointing.

After bolting the junction-box bracket assembly to the wooden strip, saw a section slightly over 1 in. wide from the center of the strip to provide space for the cutter. Normally, the fence is used with surfaces of both halves in the same plane, but they can be offset as desired—by loosening the bolts holding the junction-box halves together. The fence assembly is centered with respect to the cutter, and holes for the ¼-in. clamping bolts are located near edges of the cabinet top. A second set of holes is drilled near the back edge of the top to provide an alternate fence position.

Make a guard ring to fit over the fence gap, which can also be used on an extension arm when nonstraight edges are being shaped. The loop, made from ⅛-in. rod, is soldered to a brass plate drilled for 6–32 mounting bolts. The extension arm, made from ¼-in. plywood, is stepped to bring it nearer the cutter and improve rigidity. Bolts holding the guard and extension arm should be in one half of the guide fence only so you can adjust the other half for depth of cut.

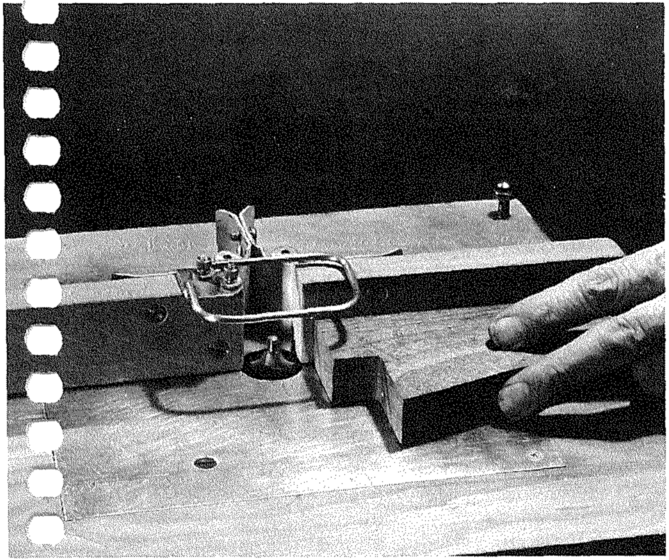
Because the router switch is not easily reached when the cabinet door is closed, you'll need an outside control. This consists of a single-pole switch and outlet (provided with ground connection) housed in a surface-mounting switch box screwed to the cabinet side. The router is plugged into the outlet.

A sizable assortment of cutters suitable for forming edge moldings, smoothing edges and other shaping chores is available. For use without a guide fence, as in cutting moldings along irregular edges, there are bits with pilots or shoulders to limit the cut. The setup illustrated had no tendency to "walk" because vibration is light. If desired, you can use C-clamps to anchor the cabinet on a table or bench.

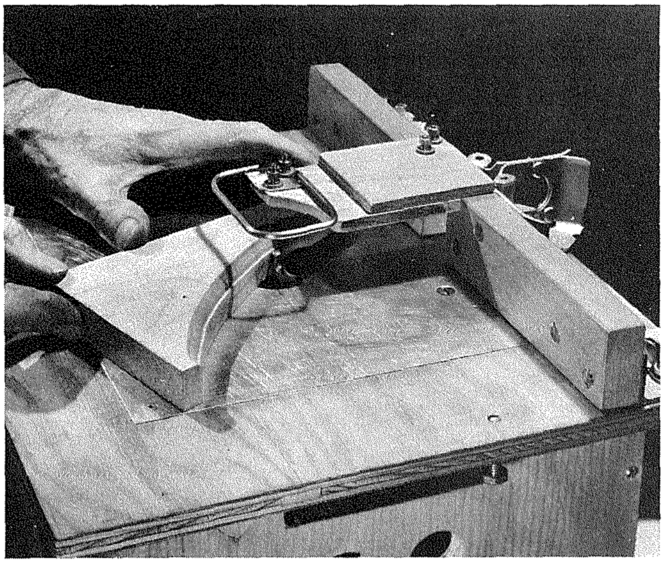
Fingers should, of course, be kept away from cutters. Instead, various work hold-downs—such as springy steel strips—can be designed as needed, mounted on the fence and supplemented by push sticks to hold work against the cutter.

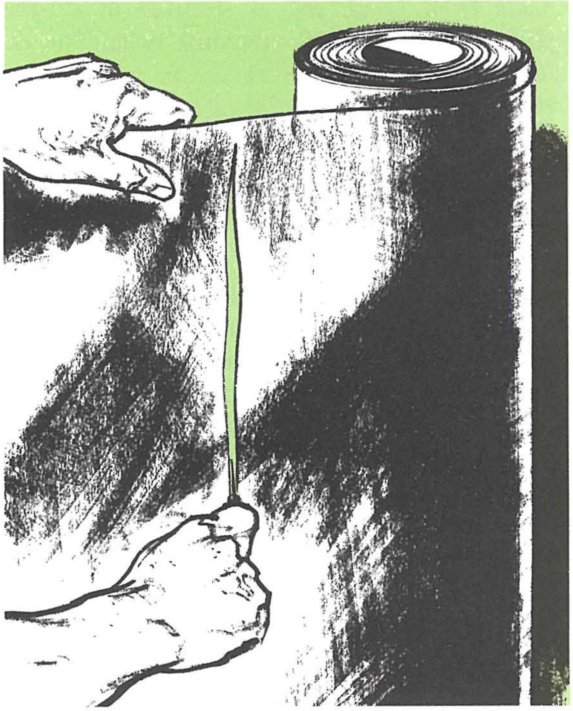
Your shaper cabinet can be finished conventionally. For the top, an easy finish is a sealer, such as thinned shellac, followed by two polish coats of floor wax. The rest of the cabinet can be varnished or painted.

TO SHAPE edges on straight work, a ring-type guard goes on the rear fence to protect fingers.

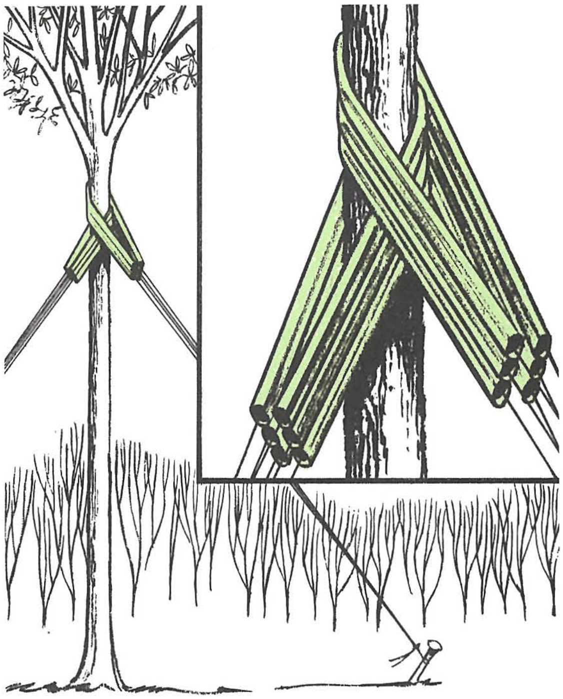


FOR CURVED work, guide fence is moved back. The ring guard is mounted on the extension.

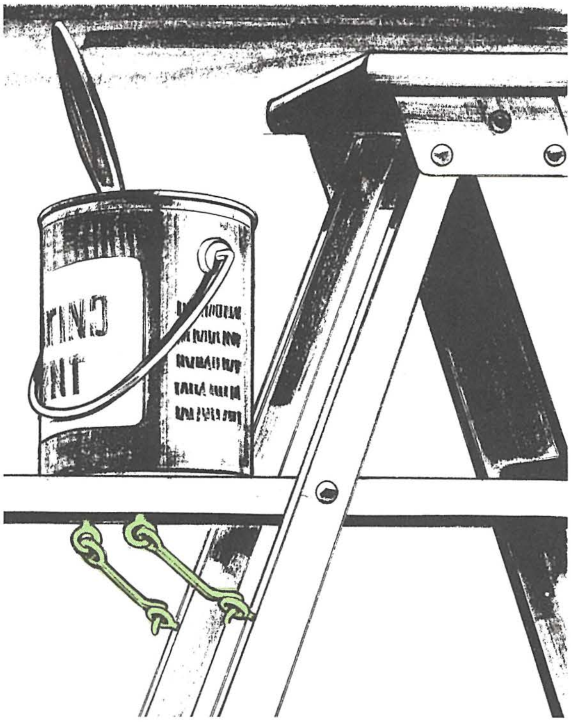




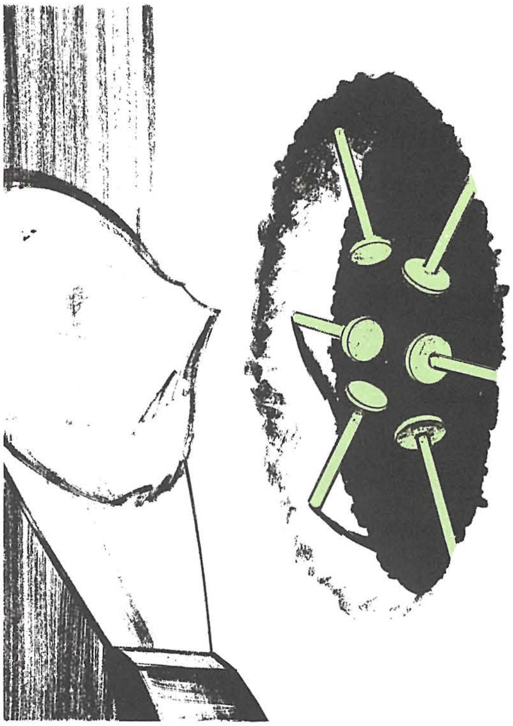
PLAY IT SMART the next time you cut a piece from a roll of paper by starting the cut a couple of inches down from the top. The uncut portion will support the piece as it's cut so it won't droop and tear.



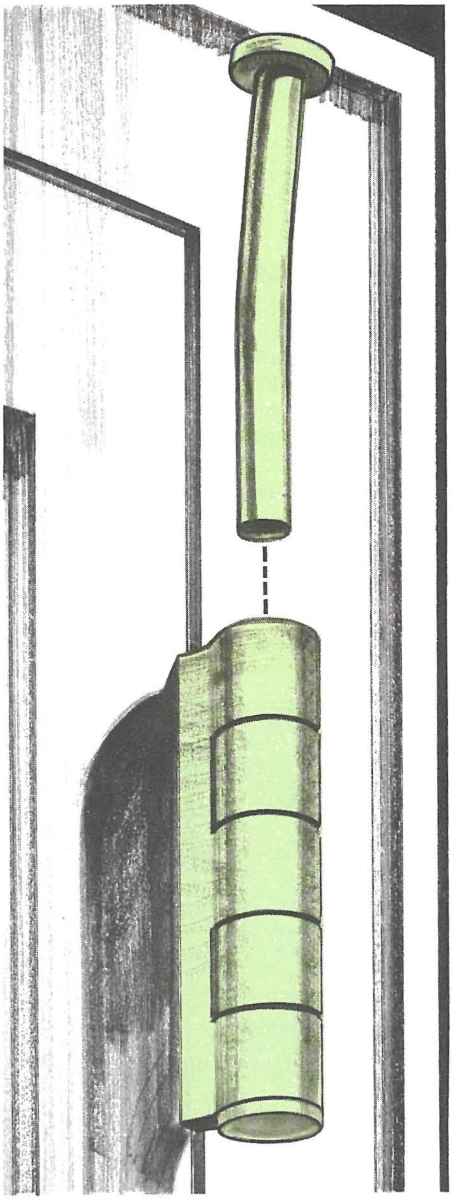
PLASTIC SOAKER HOSE is a better protector than regular garden hose when bracing young trees with guy wires. Being green, it blends better with the tree, and being flat, it "molds" around the trunk.



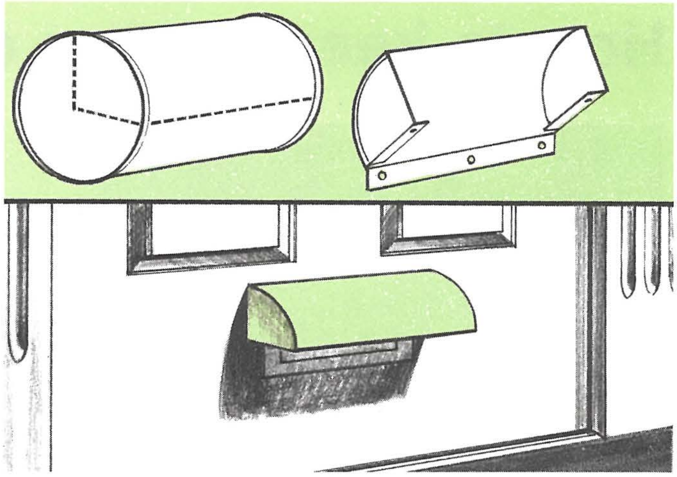
A FOLDING SHELF on a stepladder can be locked in its open position by adding a screen-door hook and eye to each side. You'll find they prevent the shelf from tipping and stabilize the ladder itself.



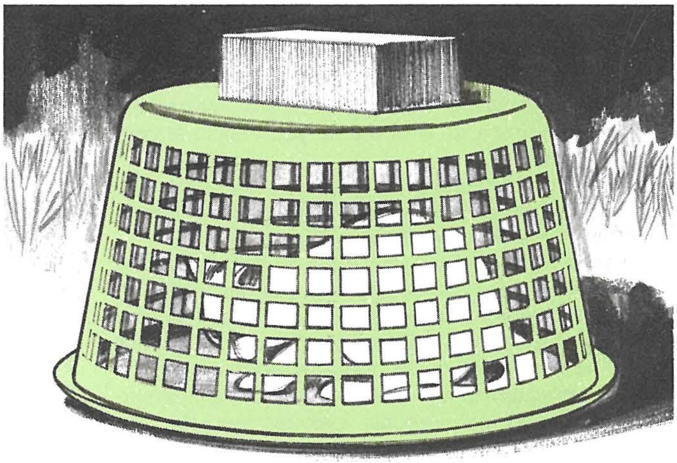
A BETTER JOB can be done when patching a hole with spackling compound if you first ring the hole with nails as shown. Radiating like spokes of a wheel, the nails will help anchor the plaster patch.



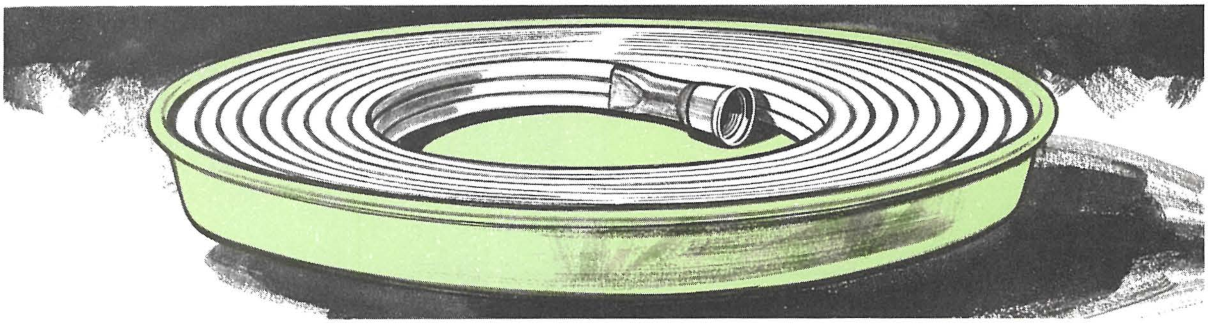
WHEN SETTLING CAUSES your door to swing shut when you want it open or vice versa, remove the hinge pins and bend them slightly with a hammer.



A TIN-CAN AWNING attached over the mail slot in a door will protect letters and magazines stuffed in the slot the from rain. It's made from a 2-lb. coffee can and painted to look like a little awning. Note in the drawing how the edges are bent.

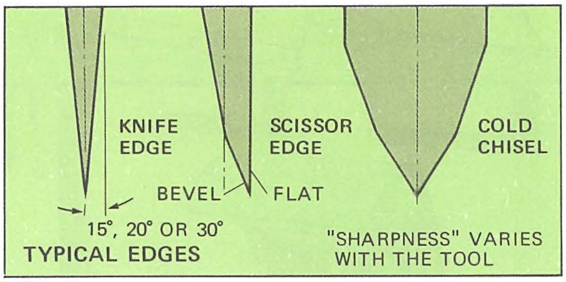


A PLASTIC LAUNDRY BASKET makes a temporary, ventilated cage for a cat that likes to wander off when you put it out. Simply turn the basket upside down over the cat and weight it with a heavy object such as a brick.



THINK TWICE before tossing away the cover of a beat-up garbage can. It's a perfect holder for a soaker hose and keeps it neatly coiled. Cut off the handle so that the cover lies flat.

How to keep cutting edges sharp



THE HOW AND WHY OF SHARPENING

It won't take you long to discover that you'll get twofold benefits from keeping all cutting edges of your various tools sharp. First, your skills with chisels, knives, gouges and the like will increase because you will have better control over the tool. Second, since a dull cutting tool is far more dangerous to work with than a sharp one, you'll minimize the chance of unfortunate accidents. (A dull chisel, for example, forces *you* to do the work that the tool should be doing, by applying extra pressure.)

Though most beginning workshoppers believe that efficient sharpening is beyond their skills, the opposite is true. Almost anyone can obtain, and keep, a sharp cutting edge rather than be forced to work with a ragged one—if he follows the basics listed on these pages.

Two sharpening rules of thumb you should always keep in mind:

☐ *Sharpen cutting tools regularly;* don't wait until they are dull and nicked because the cutting edge will then have to be reshaped on the grinding wheel.

☐ *Maintain the tool's original cutting-edge shape* (see examples above) *when sharpening.* Various tools call for specific degrees of bevel and shape: These shapes (degree of bevel) have proven to be the best for the particular job for which the tool is intended.

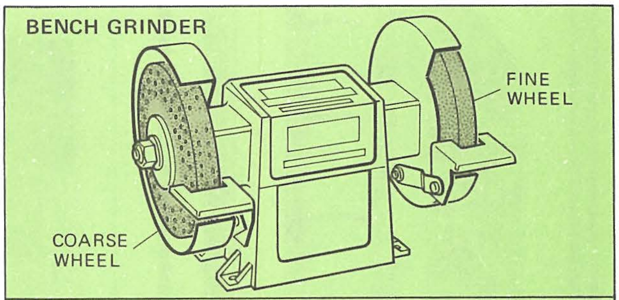
Any cutting tool that has been abused—lost its shape or nicked in its cutting edge—requires two steps for reconditioning: reshaping and sharpening. The reshaping may be done on a grinder, or with files if the tool is "soft" enough (of low carbon steel). To reshape, use coarse-grit grinding stones or files. The object of reshaping is to true a tool's edge, restore proper bevels and remove all nicks. Sharpness is *not* obtained with the coarser grits. Sharpening differs from reshaping in that only the edge requires work—removal of small particles of metal to achieve a razor edge.

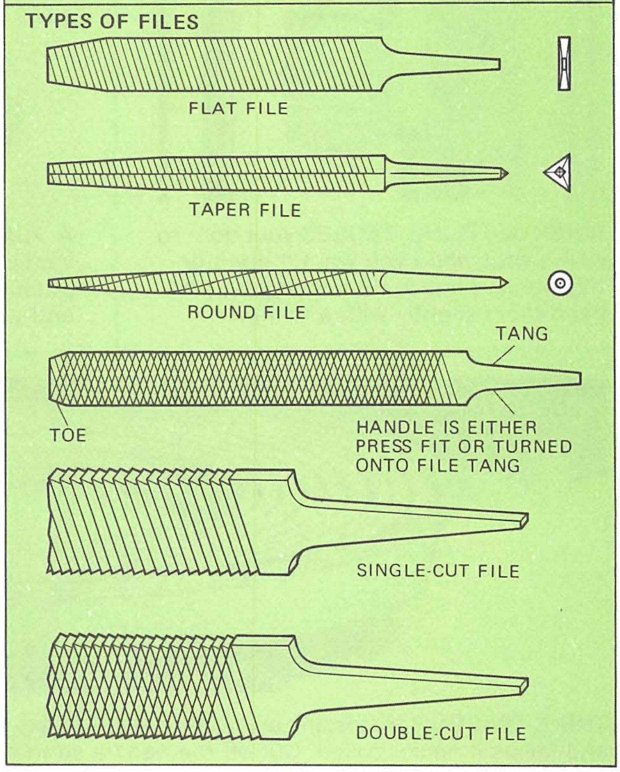
SEE ALSO

File racks . . . Grinding wheels . . . Knives, hunting . . . Scrapers . . . Toolboxes . . . Tools, hand . . . Twist drills

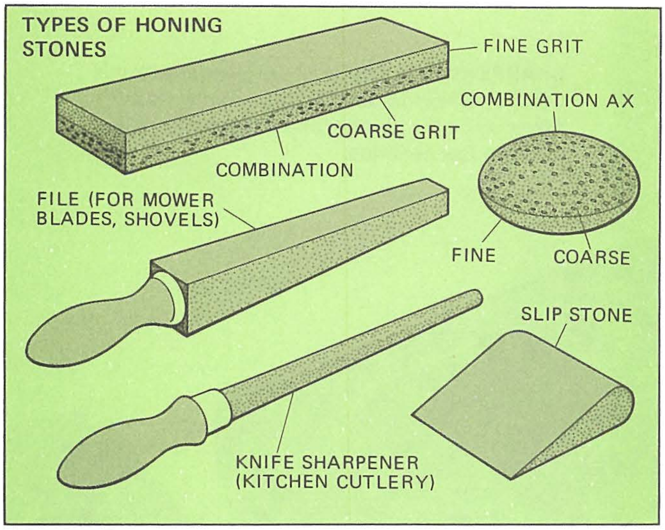
GRINDING AND GRINDING WHEELS

There are two principal types of grinding wheels: natural and man-made. The first are of fine grit and are used in water at relatively low speeds for sharpening and fine honing. To reshape an edge, switch to one of the man-made stones (available in fine, medium-fine, medium-coarse and, occasionally, in coarse). Though several types are made, best for all-around use are long-wearing bonded and vitrified aluminum-oxide abrasive wheels. Grinding generates heat; stop frequently and water-cool the tool so its temper is not drawn. If tool becomes bluish, it's too hot and has lost its hardness. After frequent use, metal particles may fill (load) the stone's pores. To dress a stone, use a steel wheel dresser; to dress natural stones, use a stone or a chunk of concrete.





TYPES OF HONING STONES


FINE GRIT
COMBINATION AX
COARSE GRIT
COMBINATION
FILE (FOR MOWER BLADES, SHOVELS)
FINE
COARSE
SLIP STONE
KNIFE SHARPENER (KITCHEN CUTLERY)

HOW-TOS OF HONING

Like grinding wheels (natural and man-made), stones must be lubricated during use, either with water or a couple of drops of fine-grade machine oil. The lubricating agent is a matter of personal preference, but most pros prefer to use oil. Oilstones are probably the most commonly used honing stone; these are flat and may be of one grit throughout, but the combination type (see drawing above) is more practical to own.

The idea of honing is to feather the cutting edge as fine as possible. To do it, alternately stroke each side with progressively lighter pressure and finer grit abrasive. It is important that every stroke be delivered in the right direction and at the right pressure. Once you have achieved a feather edge, stop. Additional honing can be, in fact, damaging because there is good chance that you will change the tool's edge shape. The tool will be sharpened properly if, when passed lightly across your thumbnail, its edge delicately removes a scant amount of nail.

Honing stones should also be redressed occasionally and stored in a covered box.

USING FILES

Low-carbon cutting edges can be reshaped and sharpened with one of the files shown at left on facing page. The bottom edge of the cutter bar on a reel-type mower, for example, can be touched up using a flat metal-cutting file. (*Never* attempt to sharpen the reel blades unless you have the special equipment such sharpening requires.) When using files to sharpen a plane iron or chisel, support tool in vise so bevel edge is horizontal and cutting edge is facing away from you. File toward the edge. For straight-edge chisels, use mill files; for gouges, round files. Follow filing with a honing.

FIG. A

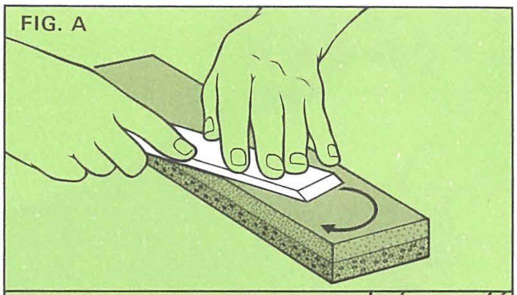
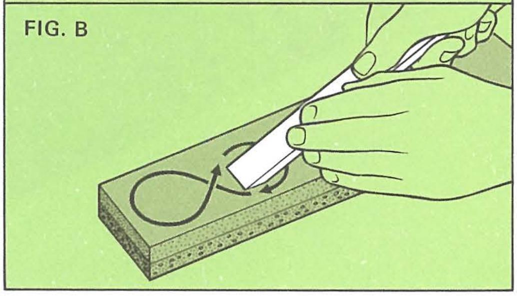


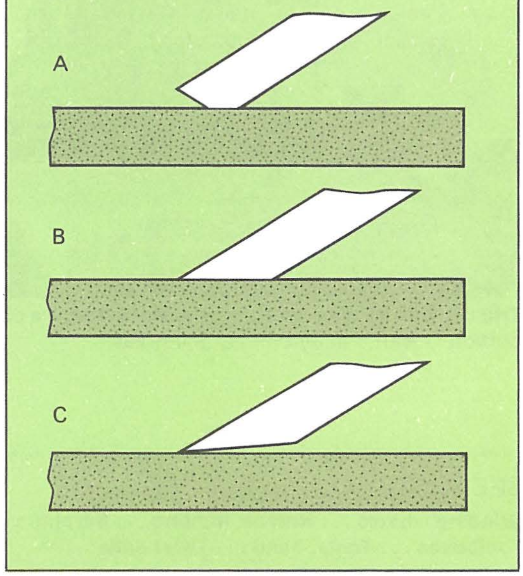
FIG. B

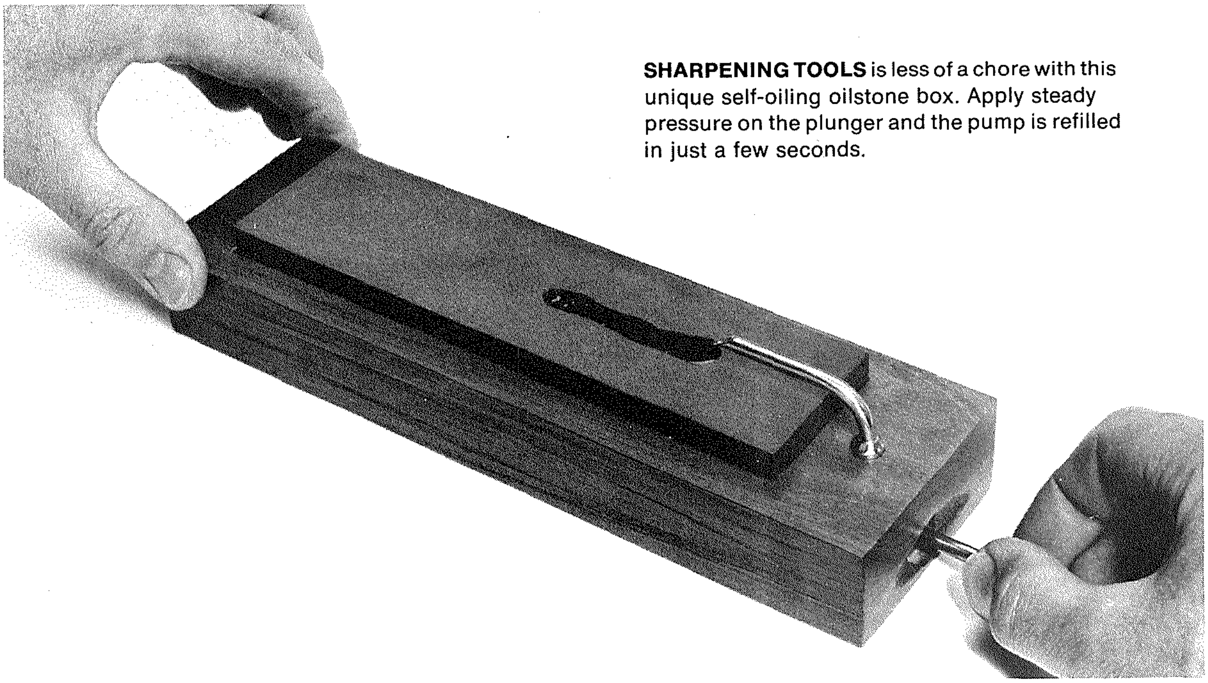


HONING A CHISEL

To stone an edge without rounding it, use one hand to control the angle and the other to apply uniform downward pressure. In Fig. A above, burrs are removed using a circular motion. To hone bevel edge (Fig. B), keep wrists rigid and move the blade in a *continuous* figure-8 pattern. To maintain an edge which is started right, it must be occasionally whetted. In A (below), the blade needs attention all around; bevel must be taken all the way down as in B and then feathered to a razor edge as shown in C.

WHEN TO WHET THE BLADE BEVEL



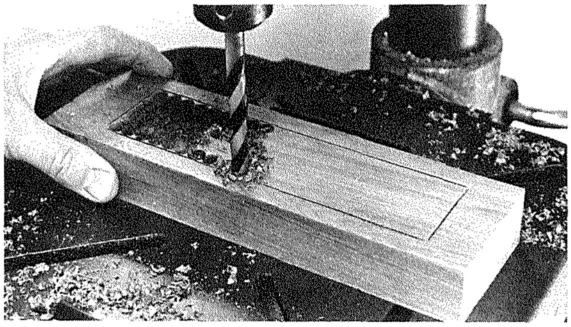


SHARPENING TOOLS is less of a chore with this unique self-oiling oilstone box. Apply steady pressure on the plunger and the pump is refilled in just a few seconds.

Make your oilstone self-lubricating

By KENNETH WELLS

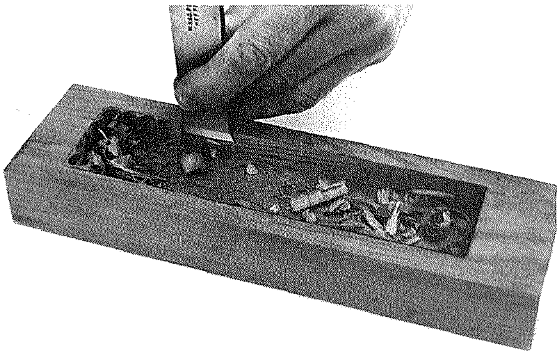
▨ THE OILSTONE HOLDER shown above looks like an ordinary box used to house and protect an oilstone. Inside, it's another story. The box houses a simple pump in the base that ejects just the right amount of oil onto the stone automatically. The dimensions given in the drawing (facing page) suit the most popular-size stone—1x2x8 in.



THE QUICKEST WAY to remove the stock from the waste portion is with a hefty bit in a drill press.

To make such a box, prepare a block of hardwood to the sizes given, then mark out the recesses in the base and lid to receive the stone and pump barrel. A drill press fitted with a router bit and equipped with a depth stop makes short work of removing the waste from the recesses although it can be done with a drill bit and chisel as shown at the right. Make the lid recess slightly larger than the base recess to provide an easy fit, and use a chisel to square up the corners of the recesses so that the stone will fit.

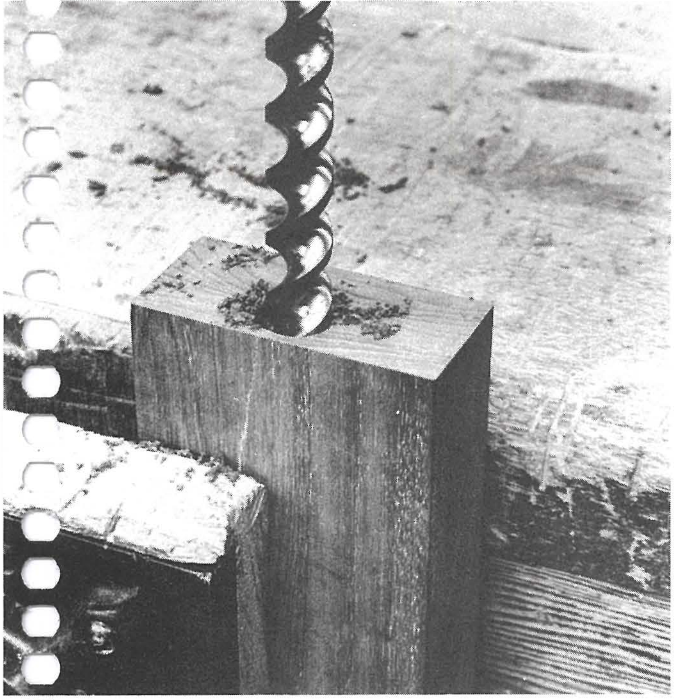
The base and lid of the box can be finished with two or three coats of polyurethane seal or shellac polish.



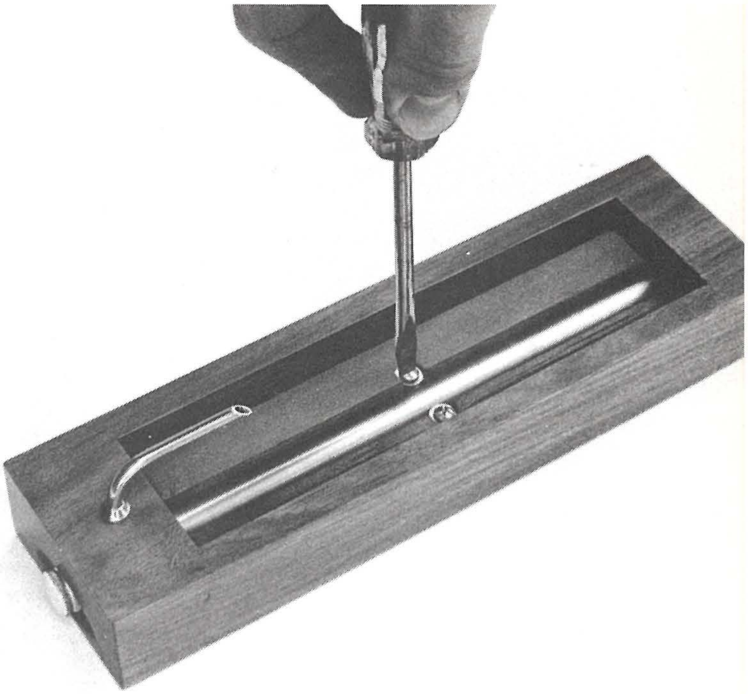
WITH MOST WASTE drilled out, a sharp chisel is used to cut a precise recess to suit your oilstone and pump.

SEE ALSO

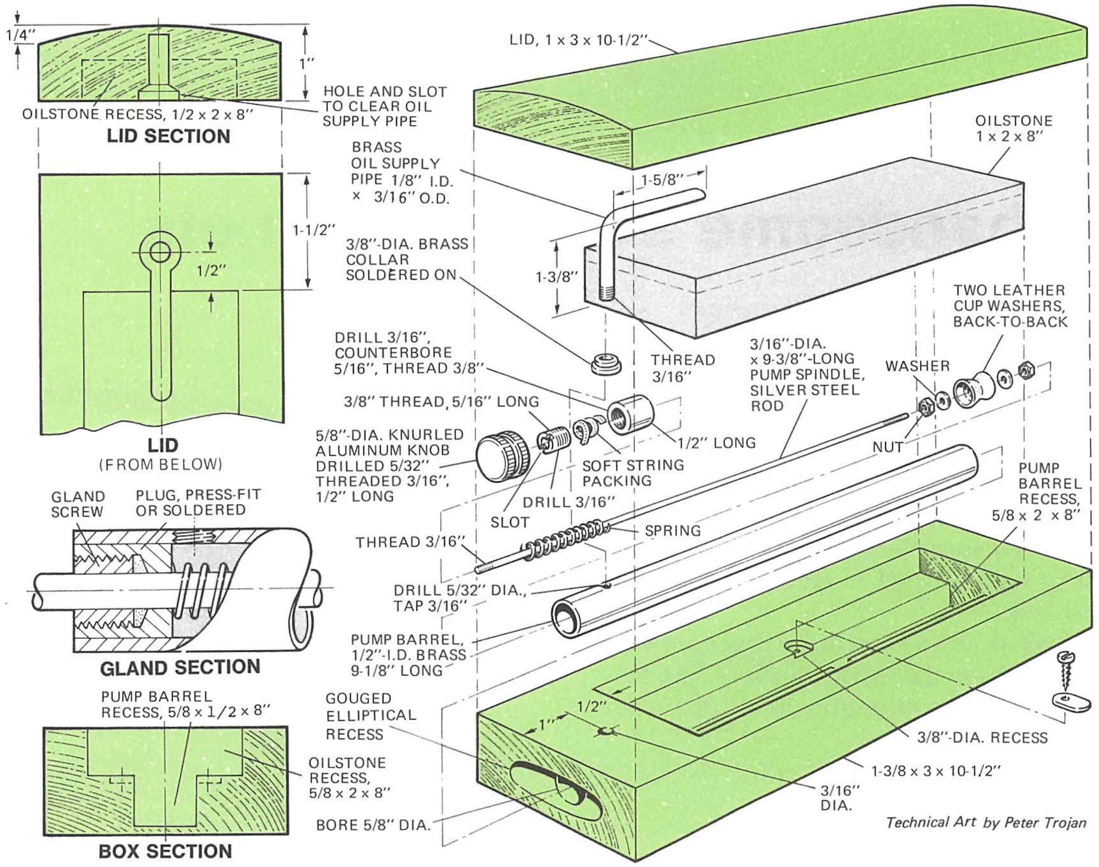
Grinding wheels . . . Knives, hunting . . . Scrapers . . . Toolboxes . . . Tools, hand . . . Twist drills



THE BOX is rigidly clamped and the hole for the pump barrel is bored using a hand brace and bit. Be sure to keep the bit vertical.

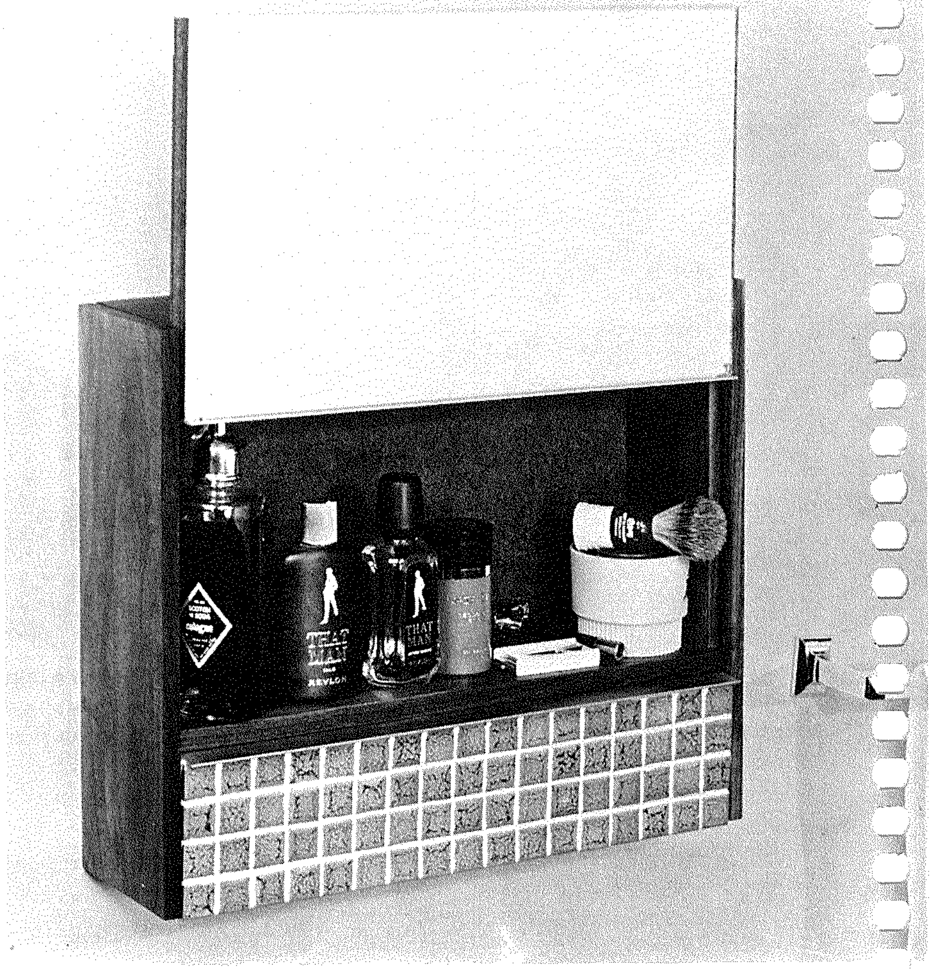


THE PUMP BARREL is being fixed in place. Besides keeping the oil at hand, the box protects your stone from collecting dust and dirt when it's in storage.


1/4"
1"
OILSTONE RECESS, 1/2 x 2 x 8"
LID SECTION
HOLE AND SLOT TO CLEAR OIL SUPPLY PIPE
1-1/2"
1/2"
LID
(FROM BELOW)
GLAND SCREW
PLUG, PRESS-FIT OR SOLDERED
GLAND SECTION
PUMP BARREL RECESS, 5/8 x 1/2 x 8"
OILSTONE RECESS, 5/8 x 2 x 8"
BOX SECTION
LID, 1 x 3 x 10-1/2"
OILSTONE 1 x 2 x 8"
BRASS OIL SUPPLY PIPE 1/8" I.D. × 3/16" O.D.
1-5/8"
1-3/8"
3/8"-DIA. BRASS COLLAR SOLDERED ON
THREAD 3/16"
DRILL 3/16", COUNTERBORE 5/16", THREAD 3/8"
3/8" THREAD, 5/16" LONG
1/2" LONG
3/16"-DIA. x 9-3/8"-LONG PUMP SPINDLE, SILVER STEEL ROD
WASHER
TWO LEATHER CUP WASHERS, BACK-TO-BACK
NUT
5/8"-DIA. KNURLED ALUMINUM KNOB DRILLED 5/32" THREADED 3/16", 1/2" LONG
SOFT STRING PACKING
DRILL 3/16"
SLOT
SPRING
THREAD 3/16"
PUMP BARREL RECESS, 5/8 x 2 x 8"
DRILL 5/32" DIA., TAP 3/16"
PUMP BARREL, 1/2"-I.D. BRASS 9-1/8" LONG
GOUGED ELLIPTICAL RECESS
1/2"
1"
3/8"-DIA. RECESS
1-3/8 x 3 x 10-1/2"
3/16" DIA.
BORE 5/8" DIA.

Technical Art by Peter Trojan

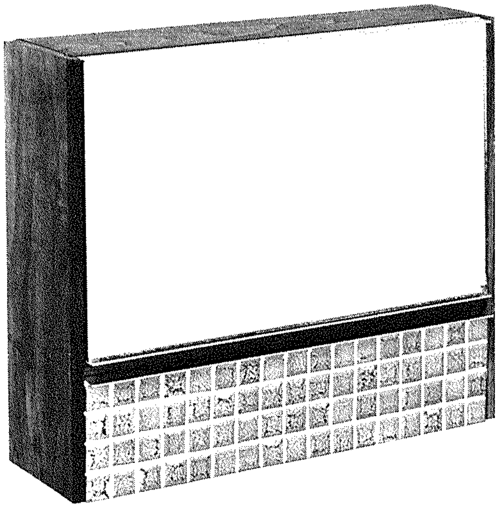
Escape from that crowded family medicine chest by building yourself one of these shaving cabinets. Both are equipped with mirror and shelf



Two handsome shaving cabinets

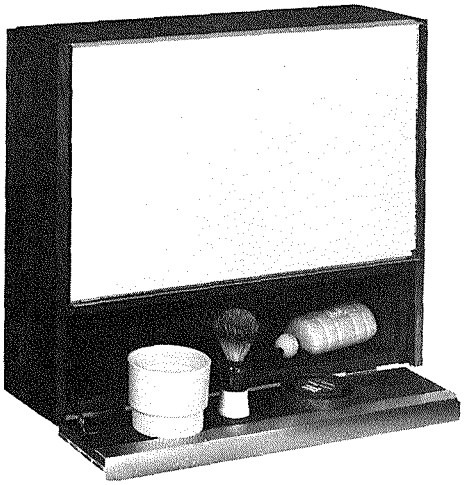
▨ GOT THE FEELING you're being gradually squeezed out of the medicine cabinet by teen-age daughters and your better half? When there's hardly room left for your razor, it's time to move out and into one of these handsome shaving bars. Placed off limits to everyone else, they'll keep everything right at hand to give you that well-groomed look.

Both designs you see on these pages are wall mounted and have their own mirrors. Both feature counters, one a drop-front affair, the other



SEE ALSO

Bathrooms . . . Toilet-top shelves . . . Vanities, bathroom

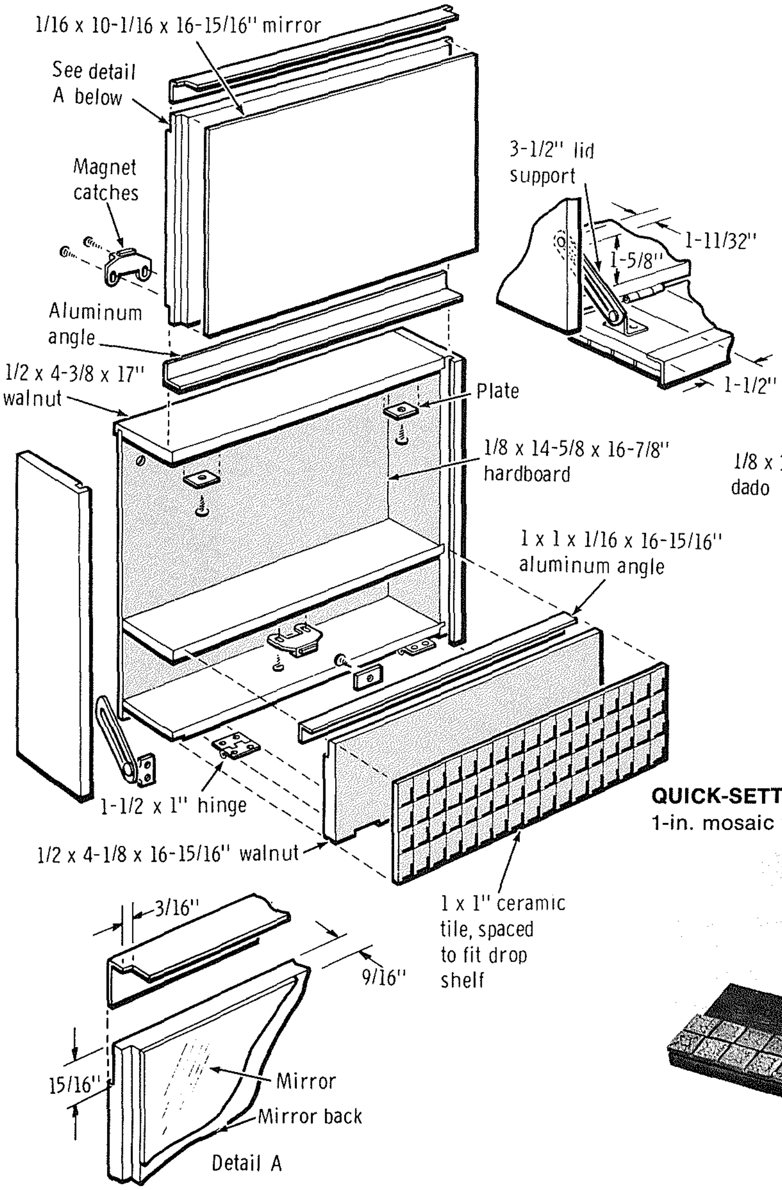


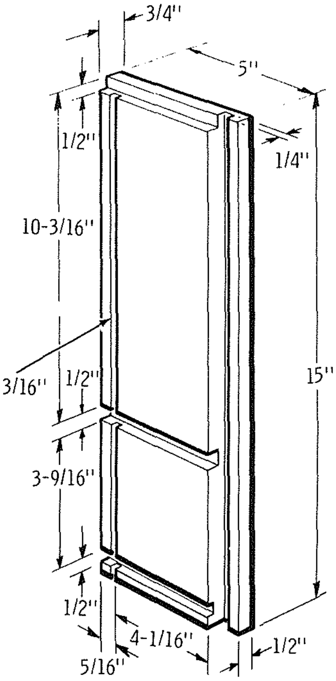
HANDY DROP-FRONT COUNTER reveals additional storage behind it. Magnetic catch holds counter shut.

an inside ledge. The former provides storage behind a lift-up mirror, the latter inside a swinging front. To top it off, both are smart looking and make handsome additions to any bathroom wall.

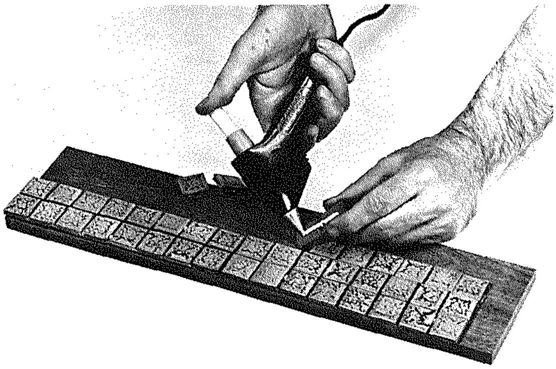
Styled by Gary Gerber, noted industrial designer, the bars combine select cabinet woods, with bright aluminum, glass and gleaming mosaic tile, and one of the handiest tools for putting all four together is a heat-type electric glue gun since it's made to order for bonding glass, tile and metal to wood. Using stick glue which bonds in 60 seconds, the gun eliminates the need for clamps.

The cabinet shown on this page is made of ½-in. solid walnut and fitted with a hardboard


1/16 x 10-1/16 x 16-15/16" mirror
See detail A below
Magnet catches
Aluminum angle
1/2 x 4-3/8 x 17" walnut
3-1/2" lid support
1-11/32"
1-5/8"
1-1/2"
Plate
1/8 x 14-5/8 x 16-7/8" hardboard
1 x 1 x 1/16 x 16-15/16" aluminum angle
1-1/2 x 1" hinge
1/2 x 4-1/8 x 16-15/16" walnut
1 x 1" ceramic tile, spaced to fit drop shelf
3/16"
9/16"
15/16"
Mirror
Mirror back
Detail A

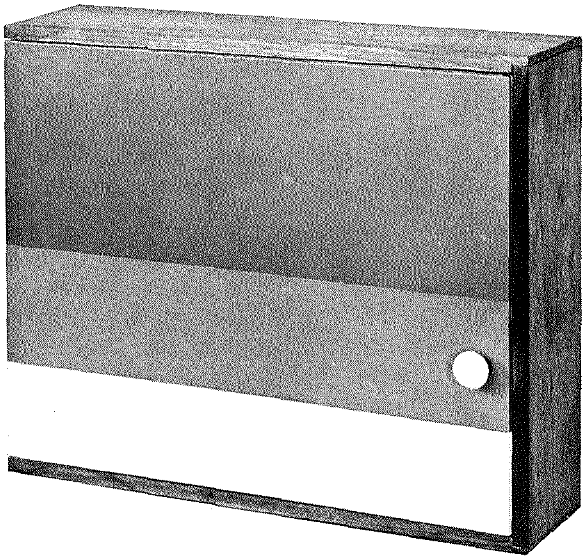


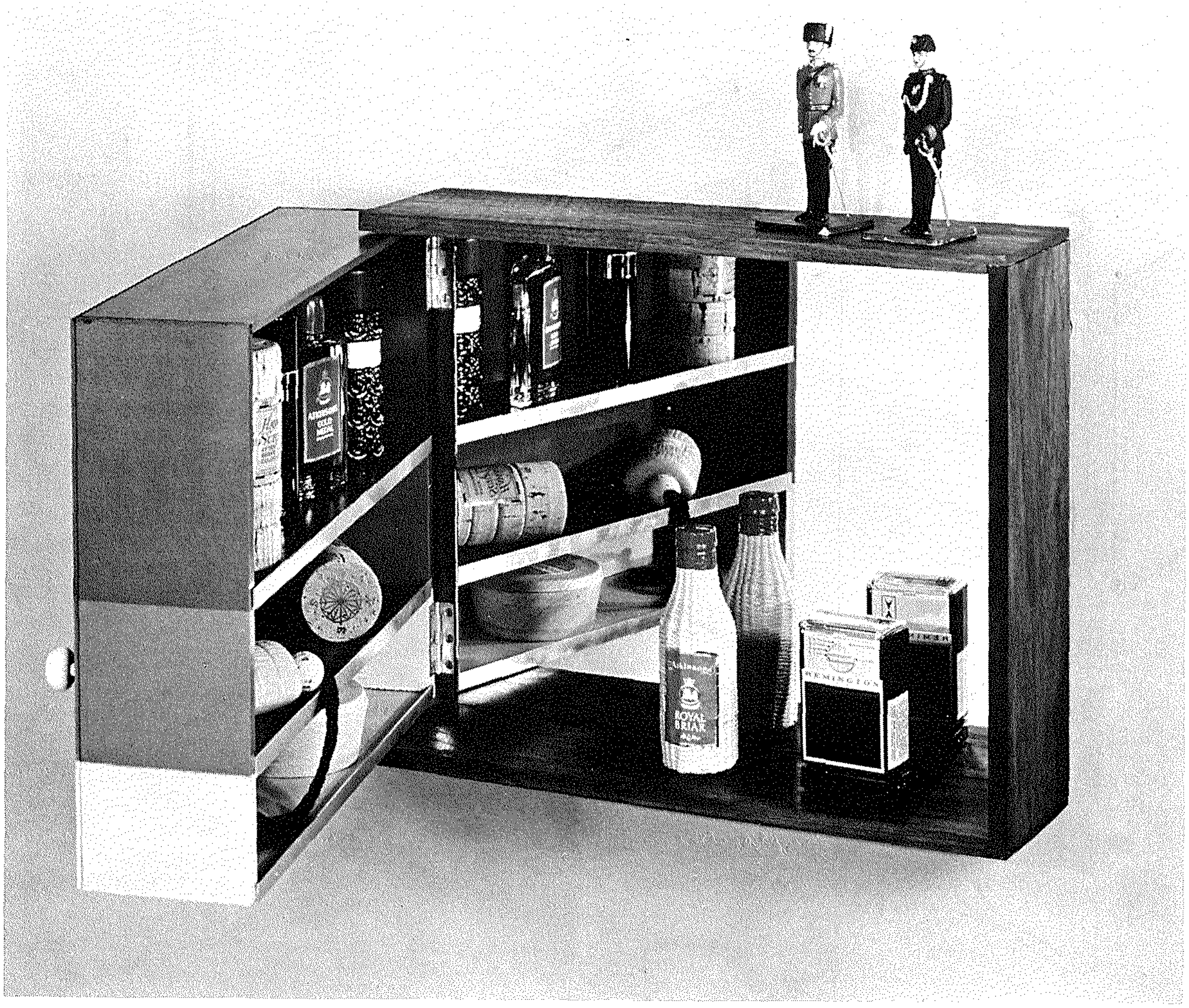
QUICK-SETTING GLUE makes a fast way of bedding the 1-in. mosaic tiles to the hinged walnut front.



back. The ends are made right and left hand, and the closeup detail shows how they are grooved at the rear for the ⅛-in. back and at the front for the 9/16-in. sliding mirror. The latter is glued to a plywood backing which is rabbeted top and bottom for aluminum-angle handles, and along the sides to fit the grooved ends. The mirror is cemented to the plywood with the glue gun. Since magnetic catches are used to hold the mirror in the raised position and are screwed to the plywood from the back, the mirror assembly must be in place before the ends of the cabinet are finally glued. Because of the catches, you can't slide the mirror in place from the top.

An aluminum angle across the top provides a handle for the tile-faced drop front. When gluing this, as well as the two metal strips to the mirror, the aluminum should first be heated so it's warm

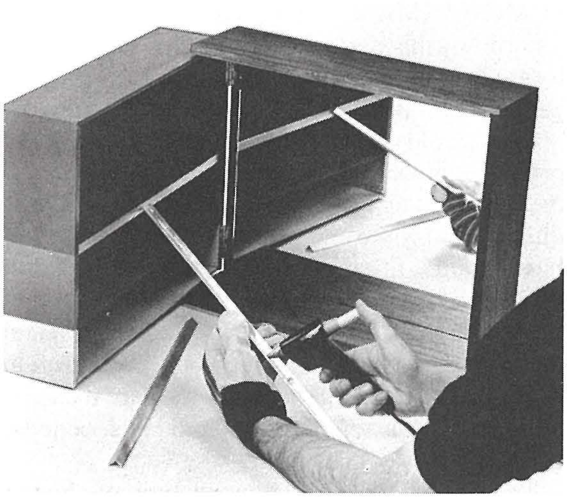




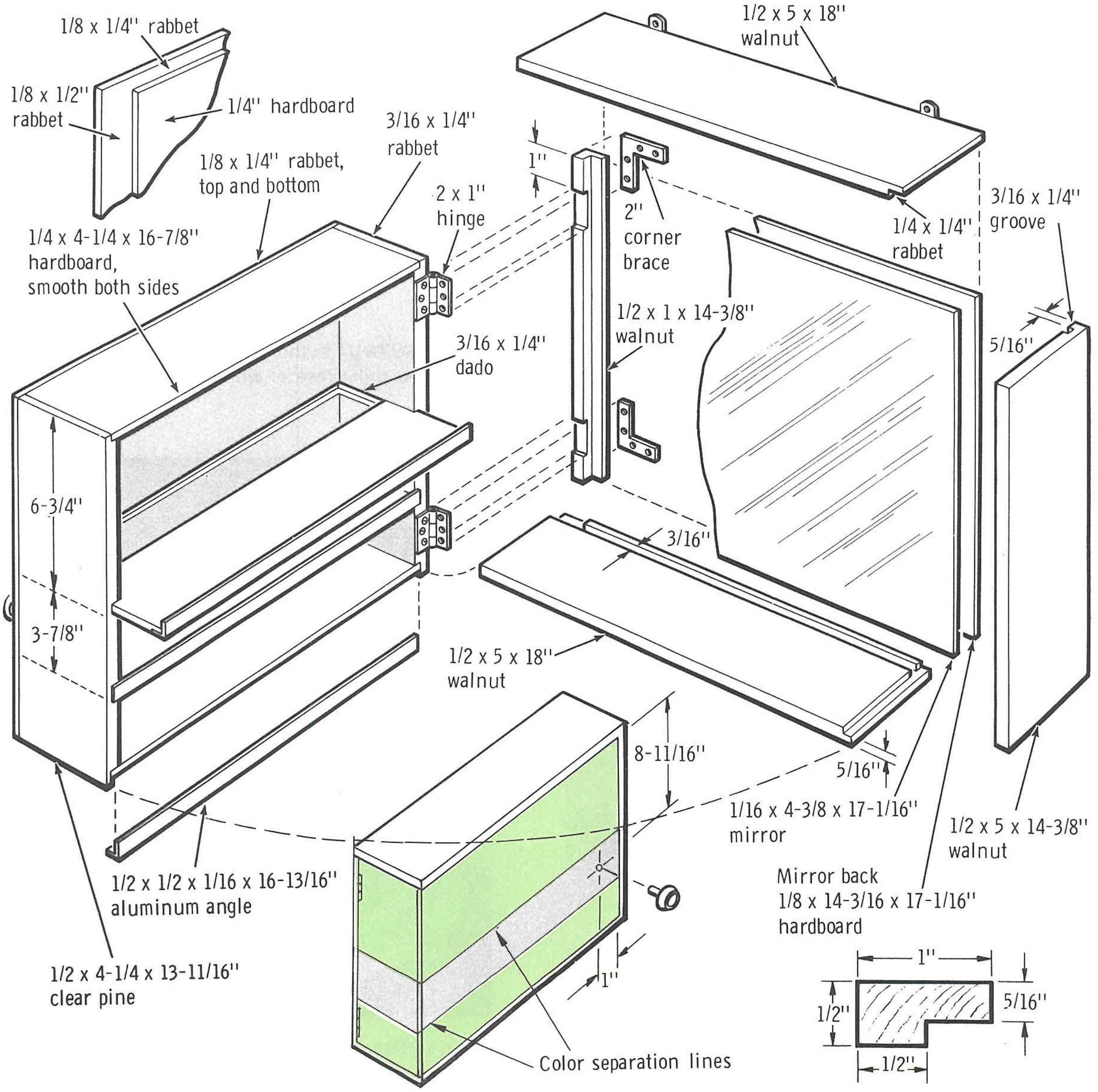
when you apply the stick glue. A magnetic catch holds the drop front shut, and a desk-lid support holds it level when open.

The swing-front cabinet detailed on these two pages consists of two separate assemblies, one nesting inside the other. The three-sided box holding the mirror is made of ½-in. solid walnut and has a hardboard back. Note how the parts are grooved and rabbeted to accept a post to which the swinging front is hinged. Since the weight of the latter is on this post, metal corner braces are added for extra support.

Pine and hardboard are used for the front unit, the pine for the ends. Aluminum angle cemented to the three shelves provides retaining edges. The swinging front is completely painted in a three-color pattern, whereas the walnut members are stained and varnished.



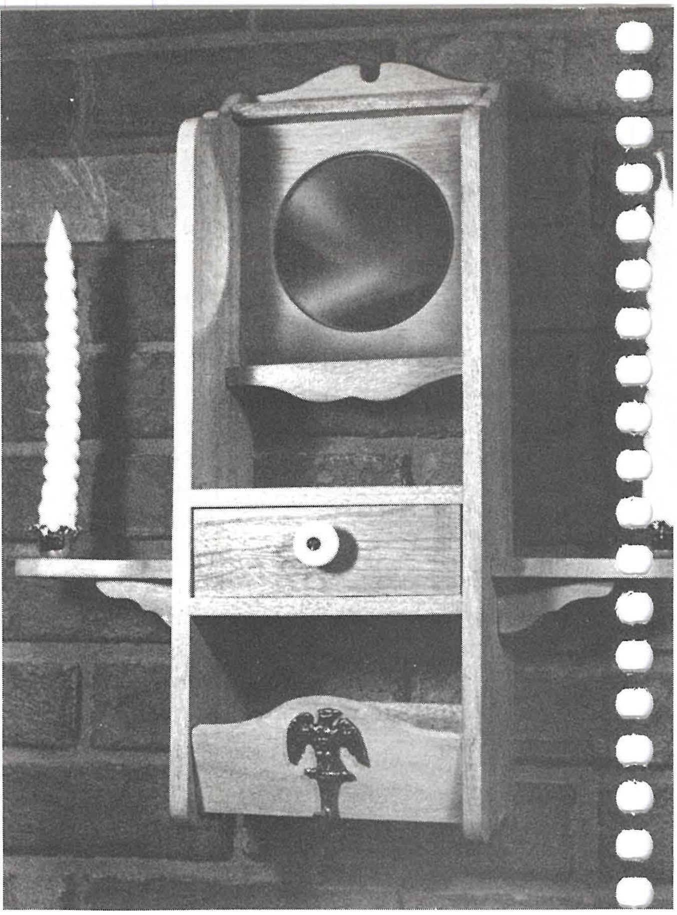
BETTER BOND is assured when cementing aluminum to the wood shelves if metal strip is first heated.



A CHARMING decorative piece for almost any room, this early American shaving console is also functional. You can use it to hold shaving gear or other items. A shelf above the mirror can display an old shaving mug, and the small drawer provides more than adequate storage for the usual assortment of shaving paraphernalia. Additionally, a comb and brush box is located at the base which is fitted with an American eagle hook that serves as a small towel holder.

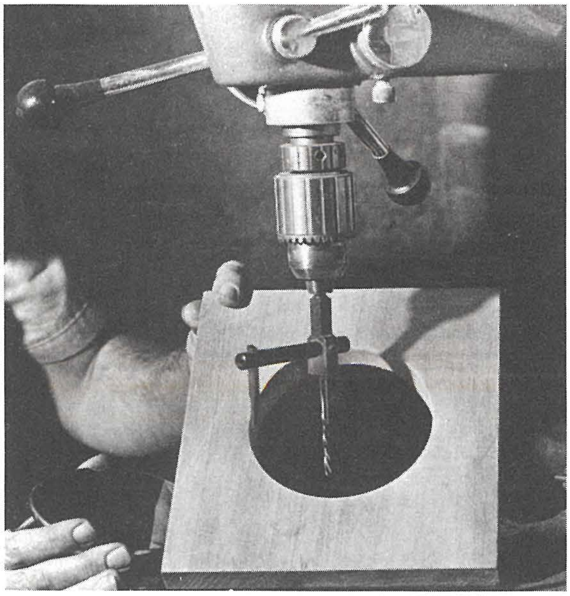
Even if the console is not used for its original intended purpose, its colonial look fits in well in any room—including the kitchen where it can be hung next to the telephone to hold pads, pencils, calendars and other items.

The shaving console shown is built of cherry; if you prefer, it will still look good in walnut or knotty pine. If you wish, a side-view mirror salvaged from an old car can be used for the looking glass.

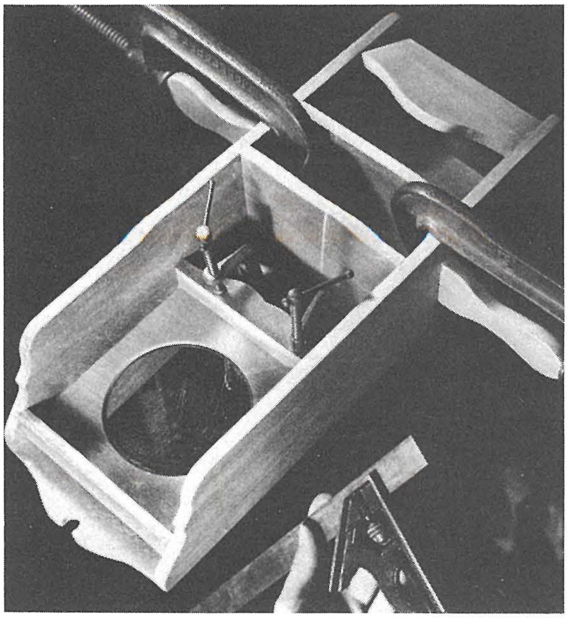


By DON SHINER

An early American shaving console



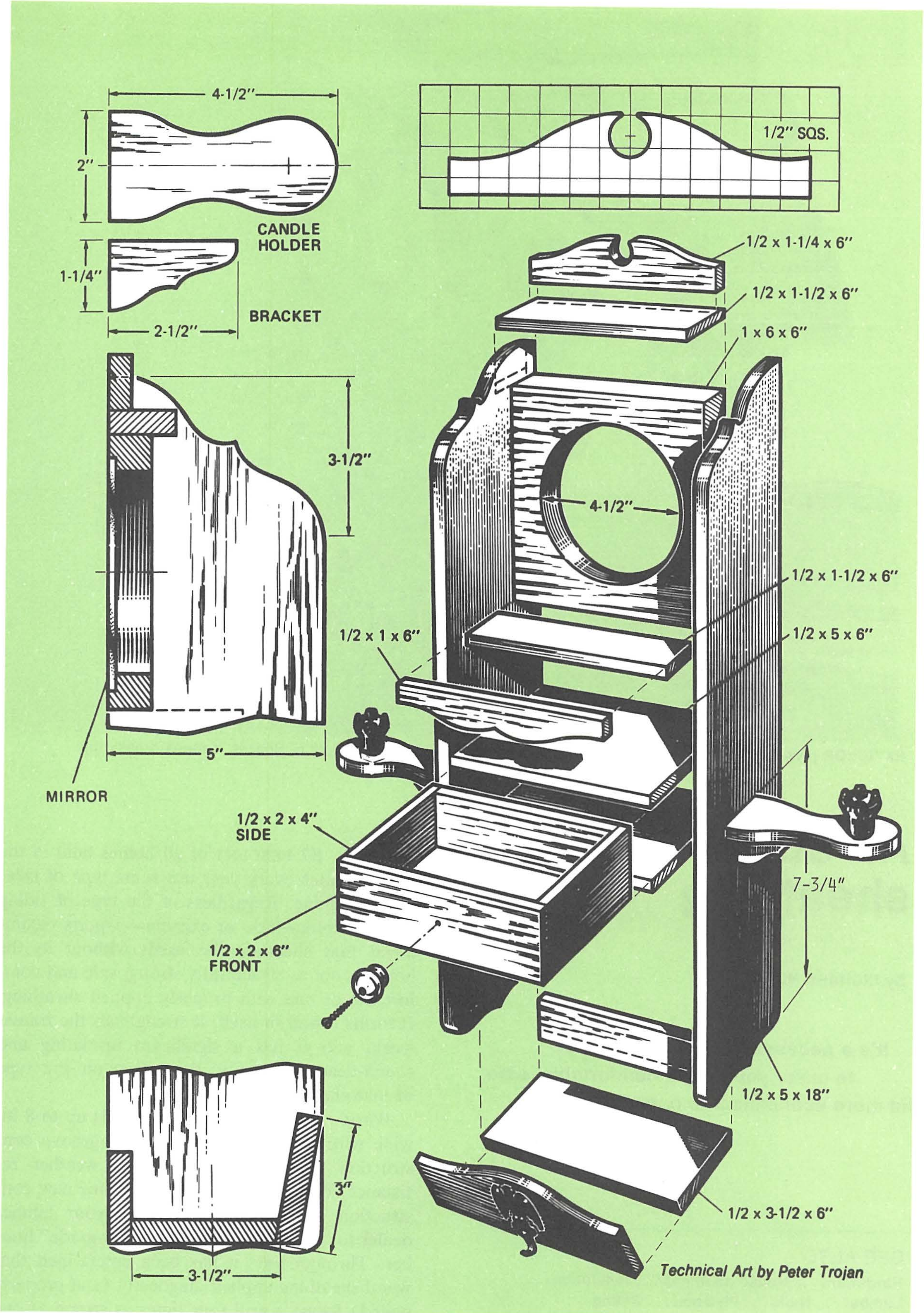
THE MIRROR CUTOUT in the rear panel is made with a circle cutter in a drill press or with a sabre saw.



BRACKETS for candle holders are glued and clamped to the side panels. Drawer is last step.

SEE ALSO

Bathrooms . . . Candle stands . . . Comb boxes . . . Kitchen accessories . . . Toilet-top shelves . . . Vanities, bathroom



Technical Art by Peter Trojan

EXTERIOR plywood siding/sheathing, "Sturd-i-wall" is single-layer construction. Boards, battens dress it up.

All about sheathing

By RICHARD NUNN

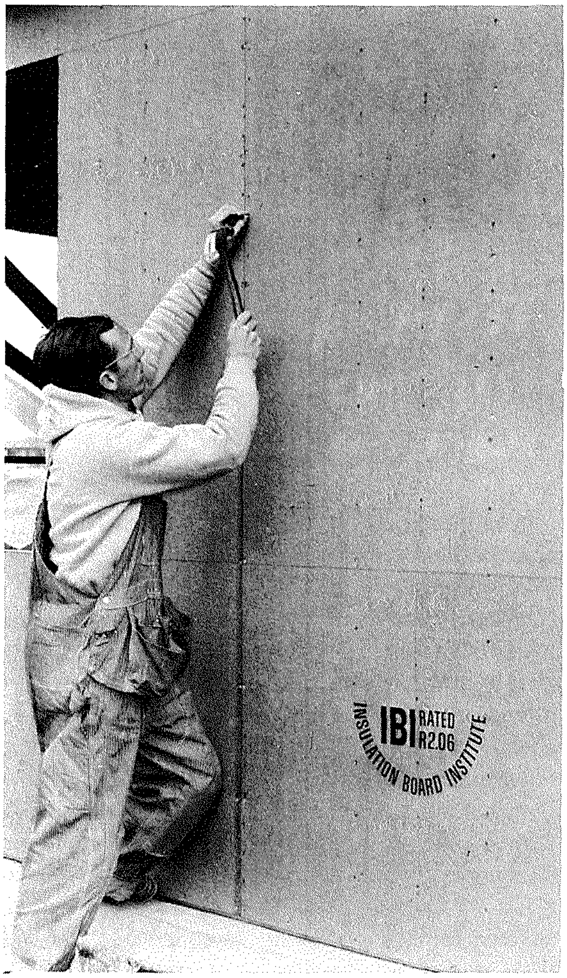
It's a necessary building product to make your home comfortable, safe, and more economical to operate

SEE ALSO

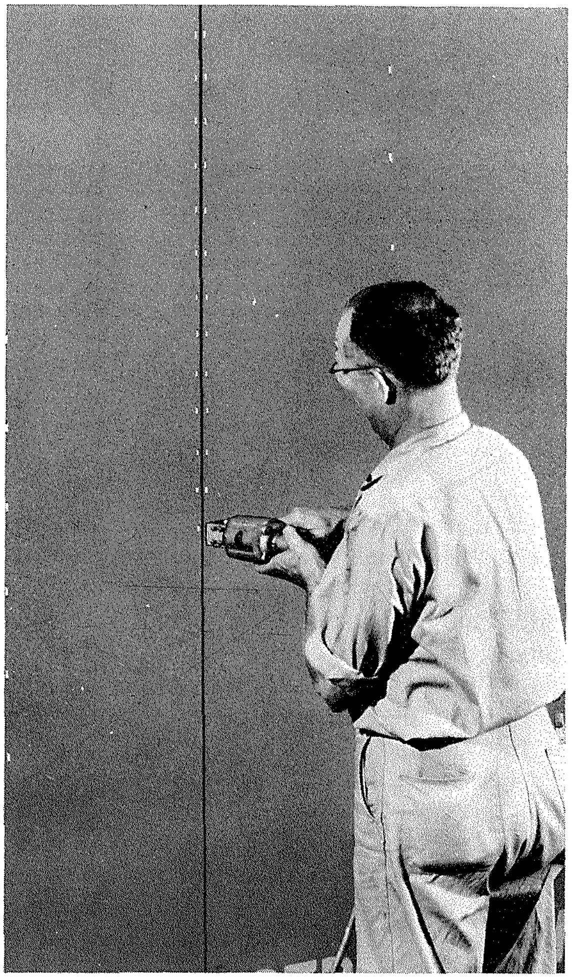
Hardboard . . . House additions . . . Insulation . . . Lumber . . . Nails . . . Plywood . . . Siding

▨ ABOUT 87 PERCENT of all homes built in the United States every year use some type of sidewall sheathing. Regardless of the type of siding on your home—new or existing—experts recommend that sheathing be used; without it, the house is not as structurally strong, safe and comfortable as one with properly applied sheathing. It forms a wall in itself, it strengthens the framework, and it has a significant insulating and sound-deadening value depending on the type of material used.

Wood sheathing consists of boards up to 8 in. wide with a shiplap or tongue-and-groove construction for added strength and weather resistance. When buying the material for new construction or making repairs, ask your lumber dealer for a quotation on "sheathing-grade" lumber. Through tests it has been determined that wood sheathing applied diagonally (and properly nailed) forms a wall four times as strong as one



INSULATION-BOARD sheathing goes up in big 4 x 8-ft. panels. It is rated for heat-resistance and also offers sound-deadening qualities.



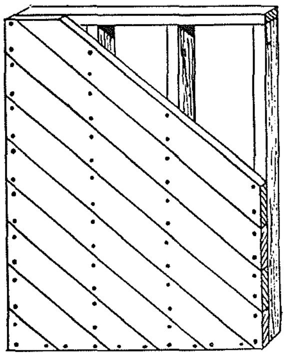
STAPLE GUN helps to install insulation-board sheathing as well as nails. Manufacturers imprint nailing schedule right on the material.

sheathed horizontally with exactly the same boards. Diagonal sheathing requires a little more material because of the trimming, but its added strength more than offsets the additional cost involved (see page 2298).

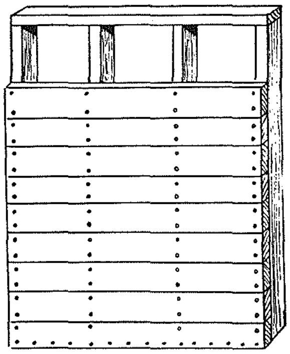
Plywood sheathing will add great strength and rigidity to any structure, and plywood also is ideal for shear walls engineered to resist lateral loads. Plywood sheathing produced by mills belonging to the American Plywood Association is marked "Standard INT-DFPA." The most common thicknesses are 5/16, 3/8, 1/2, 5/8, 3/4 and 7/8 in. The veneer grade is C face, D back and inner plies. When plywood sheathing is used, building paper and diagonal wall bracing can be eliminated. Common smooth 6d nails or annular, spiral-threaded galvanized box nails, or T-nails of the same diameter can be used. Staples can also be used, but at a reduced spacing. If siding such as shingles will be used over the plywood sheathing, you must apply the plywood to the studs with the face grain running across the studs.

Gypsum sheathing has a gypsum-rock core enveloped in a heavy, water-repellent paper. Because of the core, a conventional wall built up with a layer of gypsum sheathing has a fire-resistance rating, depending on the type of construction used. The sheathing is made in sheets 1/2 x 24 x 96 in., which are quick and easy to install. The tongue-and-groove horizontal edges fit snugly together to reduce wind penetration. The material costs less than wood sheathing. It does have one limitation, however: It can't serve as a nailing base. Wood siding, furring strips and wall ties must be nailed through the sheathing and into the framing members.

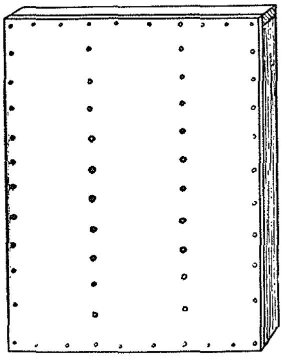
Insulation-board sheathing is probably the most common of all sheathing products used today. The material provides more insulation value than competitive sheathing products. Be-



DIAGONAL WOOD
REQUIRES 1350* SQ. FT.
TO COVER 1000 SQ. FT



HORIZONTAL WOOD
REQUIRES 1150* SQ. FT.
TO COVER 1000 SQ. FT.



INSULATION BOARD
REQUIRES 1050** SQ. FT.
TO COVER 1000 SQ. FT.

*Includes Dimensional Loss and Estimated Cutting Waste
**No Dimensional Loss with Fiberboard

cause it is applied over the studs as well as across the spaces between the studs, the sheathing covers the entire wall area with a uniform layer of insulation. It is manufactured from scientifically processed wood or cane fiber. The fiber is reduced to a pulp and reassembled under heat and pressure to form the sheets.

Insulation-board sheathing is produced in two thicknesses: ½ and 25/32 in. Available board sizes are 2 x 8, 4 x 8 and 4 x 9 ft. Other sizes are made on a special-order basis. Two other products are also available: nail-base and intermediate fiberboard sheathing. Intermediate, manufactured in 4 x 8 and 4 x 9-ft. sheets and in ½-in. thickness, eliminates the need for corner bracing in frame construction when it is nailed according to recommendations.

Nail-base sheathing, available in the same sizes as intermediate sheathing, is a high-density product that also eliminates the need for corner bracing frame construction. With nail-base, you can apply wood and asbestos cement shingles directly to the sheathing with annular grooved nails. With regular fiberboard sheathing and ½-in. thick intermediate sheathing, wood furring strips must be used for wood or asbestos cement shingles. You can apply wood shingles to fiberboard shingle backer in combination with any fiberboard sheathing, using annular grooved nails. The wood furring strips can be omitted.

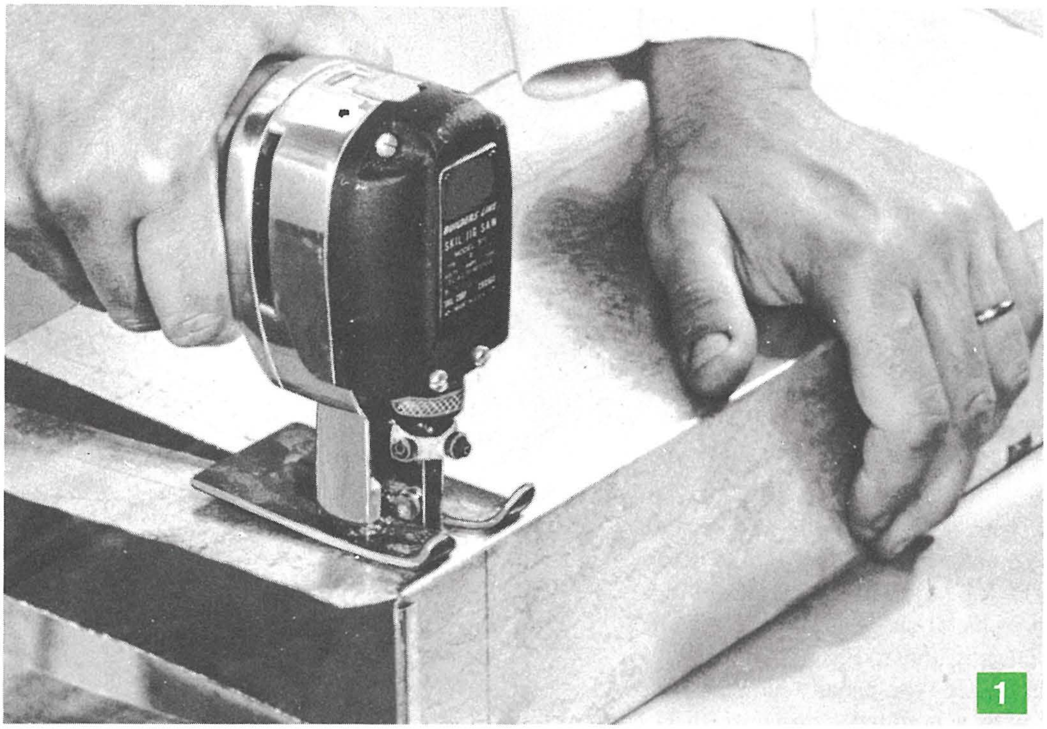
Other features of the material include easy handling, light weight, better workability and better bracing strength. Since the material is water repellent and forms a weathertight cover, no building paper is required, resulting in a savings of about $20 per average house.

The sheets of insulating-board sheathing are applied vertically to the walls. When the material is used without corner bracing, staples or nails should be applied to the intermediate studs first, and the fasteners must be spaced not more than 6-in. on center.

Where 2 x 8-ft. sheets of the material are used with tongue-and-groove or shiplap joints, apply it at right angles to the framing members. Supplementary corner bracing is required. The sheathing should be applied with a ⅛-in. space between the ends of the boards. Make sure the interlocking long edges of the boards fit snugly with the tongues up. Nail to the intermediate framing members first with the fasteners spaced 8 in. on center. Nail the vertical edges next, spacing the fasteners 4 in. on center and not less than ⅜ in. from the edge of the sheathing panel.

Cement-asbestos board is a special building panel manufactured by covering a core of cane-fiber insulation board with surfaces of cement-asbestos. The bonding adhesive is moistureproof, and the material somewhat resembles a sheet of precast concrete. This material can form a complete exterior wall in itself. The surface is durable, weather and fire-resistant, stone-gray in color and can serve as an exterior surface without any further finishing treatment. The material is also used for interior partition walls where fire-resistance is specified.

Shingle-backer board is an insulating material similar to insulating-board sheathing. It is used as a backing for shingles and some types of siding such as aluminum. The material eliminates the need for undercourse shingles, adds insulation value and strengthens and deepens the attractive "shadow line" of the shingles. Backer board is made in sheets measuring 4 ft. long and, depending on the manufacturer, something under 12, 16 or 18 in. wide to undercourse shingles of those sizes.



1

CUTTING SHEET-METAL stock calls for a saber saw or portable jigsaw as shown above; snips, several of which are shown in Fig. 25; or professional equipment such as the squaring shear shown in Fig. 2. Ordinary snips take care of metal as thick as 22 ga. handily. To follow a pattern accurately, it's important to score lines clearly on the surface of the metal, then to follow those lines carefully. When possible, use a straightedge to keep the scribe on the track.

Know-how of working sheet metal

By C. W. WOODSON

BASIC SHEET-METAL WORK requires only metal snips or shears and a squared hardwood block or two over which to make bends. Anvils, more tools and shaping devices, and bench stakes for seams and radius bends will let you go beyond simple projects. Beyond this point, you enter the professional area with its hand and powered machines and advanced ways to develop sheet-metal shapes.

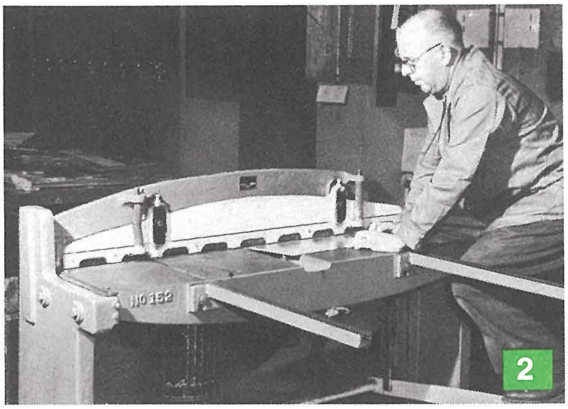
Whatever your level may be, you'll find sheet-metal work is satisfying.

Three basic methods of developing a given shape are shown in representative form in Figs. 3 through 6. These by no means cover the field of development, but do indicate methods of procedure. The shortcut, rollation method in Fig. 3 is quite widely used in the development of the more simple forms. Figs. 12 and 14 through 16 show how it is carried out when making the top of a funnel or similar bell shape. The joint in the funnel top, or bell, can be seamed as in detail A, Fig. 11, and hammered flat as in Fig. 12, or can be sweat-soldered before soldering on the neck, Fig. 11, B. For procedure in laying down a conical shape (or what is to become a conical shape) note the right-hand detail in Fig. 3 and compare with Fig. 14. The cutout in Fig. 14 is then bent as in Fig. 15 and the edges chalked. The final step in the rollation method is pictured in Fig. 16. The other development methods such as parallel-line development, Fig. 4, radial-line development, Fig. 5 and development by triangulation, Fig. 6, are used in advanced work in the laying down of large and involved shapes.

Nearly all sheet metals, both ferrous and nonferrous, of 22 ga. or thinner can be cut easily with ordinary tinner's snips, Figs. 14 and 25. Heavier metal is best cut with compound-lever shears, or

SEE ALSO

**Arbor presses . . . Cutoff machines . . .
Hydraulic presses . . . Jigsaws . . . Machining . . .
Metal casting . . . Power hacksaws . . . Sabre saws . . .
Torches**



2

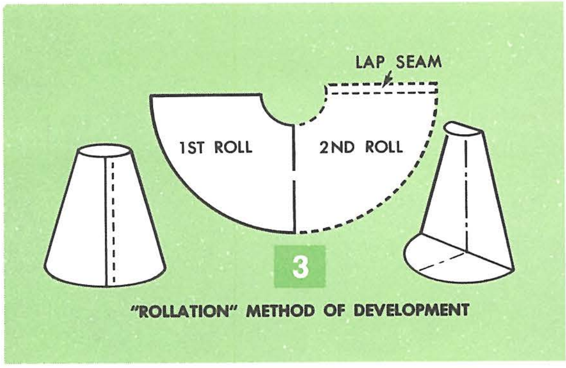
FOOT-OPERATED squaring shears like this are standard in professional or large school shops.

with a hacksaw with a blade having at least 24 teeth per inch. You also can use a portable jigsaw (or saber saw), Fig. 1, with a metal-cutting blade. Many sheet-metal shops and some school shops have a squaring shear, Fig. 2. Foot-operated units of this latter type usually handle mild steel to 16 ga. with a nominal cutting width of 30 in. or more.

Hand-wiring an edge, Fig. 8, is a good test of one's skill as a tinsmith. In shops this job usually is done on a machine, Fig. 17, but you can do a creditable job by hand as in Fig. 8, using a wood mallet and a pair of pliers, as in the accompanying photo, Fig. 7. Start with a right-angle bend in the sheet as in detail A. Turn it back on itself with the wire inside as in detail B, using the mallet and the pliers in conjunction to make a smooth bend. Wiring usually is done before the part is formed. You'll find wired edges on such commonplace items as pails, pans, funnels, garden carts—almost any open-top container made from sheet metal. A wired edge adds greatly to their strength, durability and appearance.

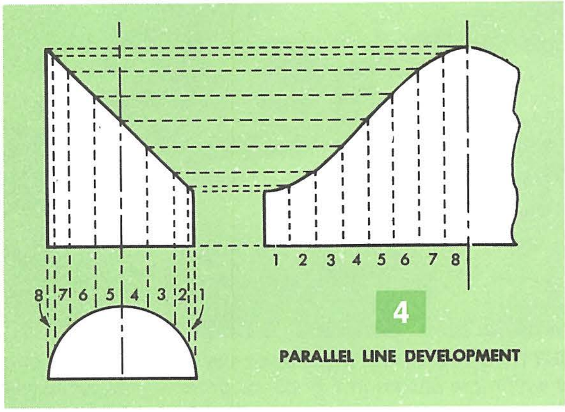
Another step in simple forming that you should be familiar with before tackling any type of corner joining is the method of notching and clipping at corners to produce neat, attractive work. The square notch, used on simple boxlike forms, permits corners to be fitted tightly, details C and D, Fig. 9. The V-notch can be cut as in detail B, producing an overlap for riveting or soldering, or can be cut as in detail A to form a neat corner without an overlap. It also is used for double seaming on work having inside flanges. Bend the flanges against a solid hardwood block as in detail E, using a wood mallet or a soft hammer to prevent denting or scoring the metal.

Progressive steps in making a dovetail seam of one type are shown in Fig. 13. This method is



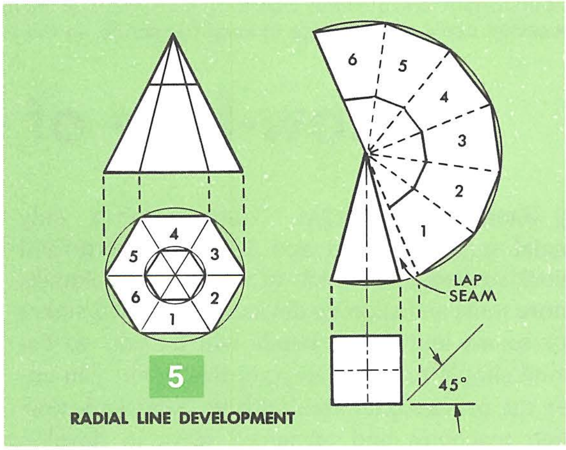
3

"ROLLATION" METHOD OF DEVELOPMENT



4

PARALLEL LINE DEVELOPMENT



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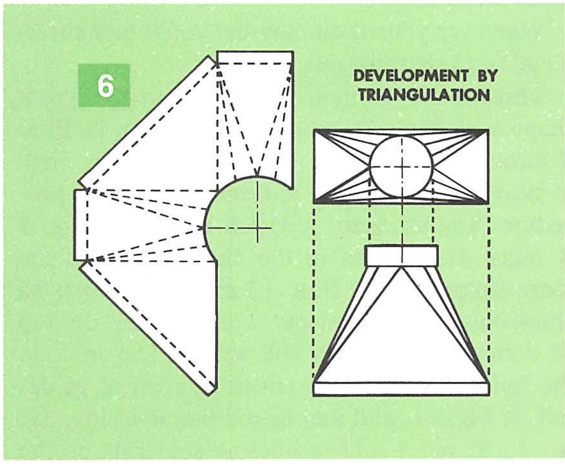
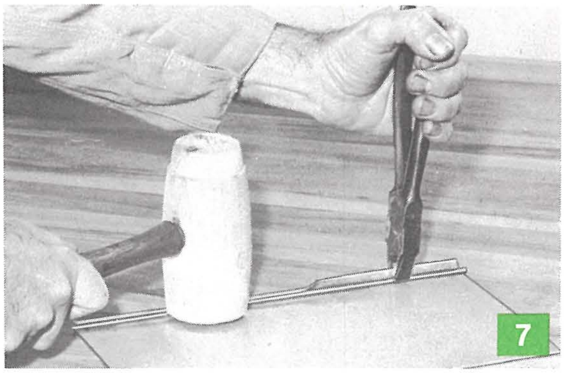
RADIAL LINE DEVELOPMENT



6

DEVELOPMENT BY TRIANGULATION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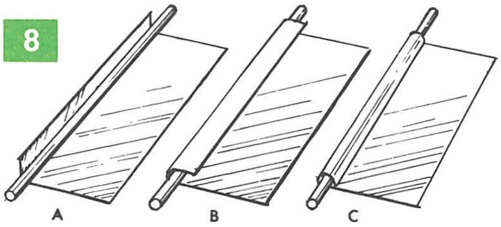
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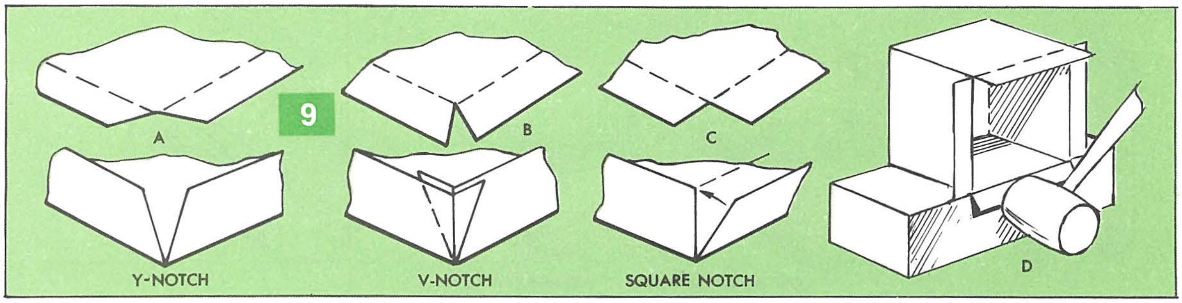
WIRING AN EDGE by hand tests tinsmith's skill. Photo at the left shows how mallet and pliers are used together to bend the edge. The detail drawings above show the three basic steps in the hand-wiring process.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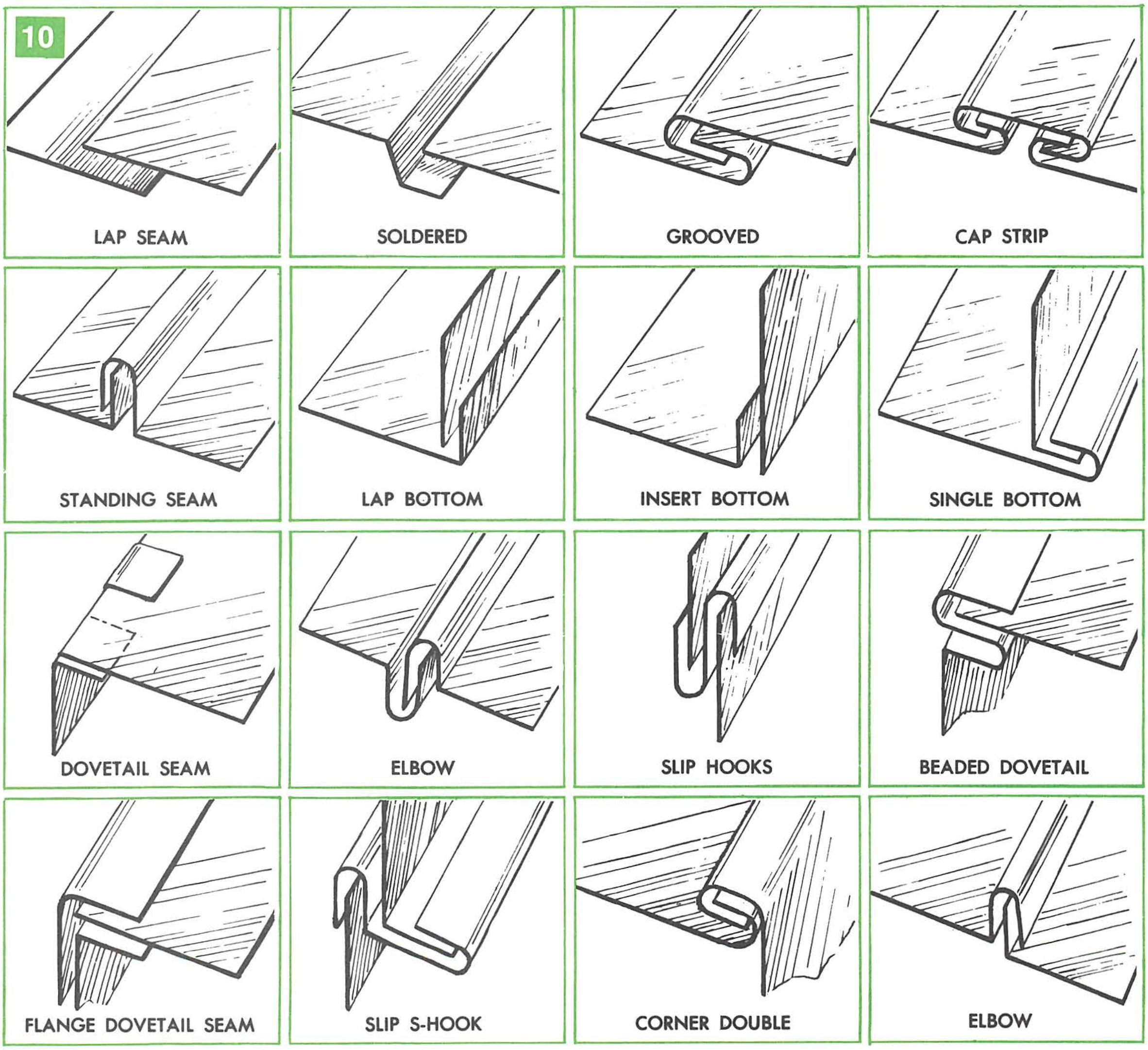
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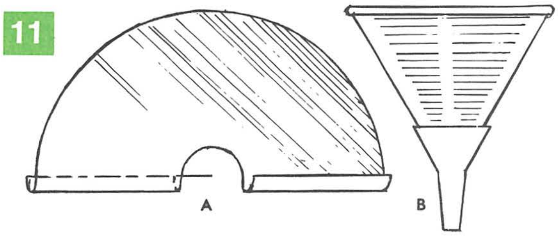
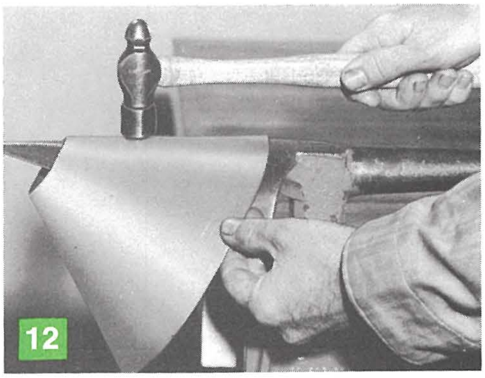
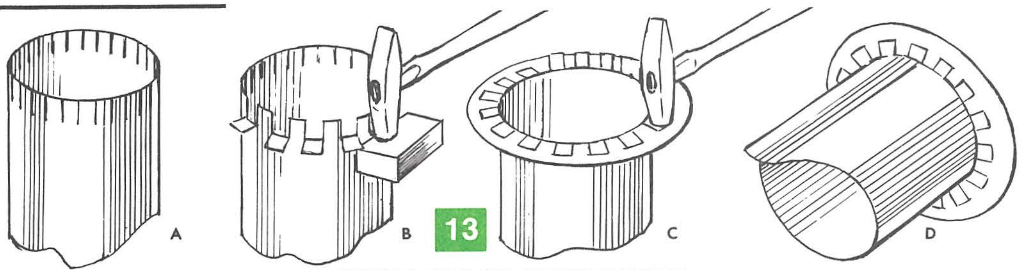


IN CUTTING a funnel top or bell, leave room for a lap joint at an end—or a grooved joint at both ends. Use of the rollation pattern is shown in Figs. 14 through 16.



12

working sheet metal, continued



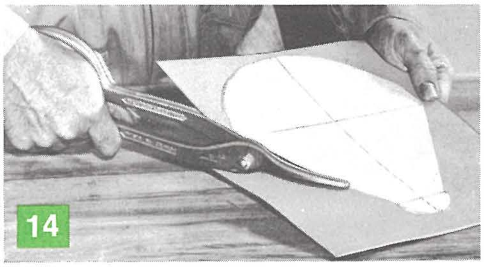
13

DOVETAIL SEAM FOR ATTACHING FLANGE

often used when joining a flange to a cylindrical shape. The latter is scribed near the end with a visible line and is then clipped at spaced intervals as in detail A, the cuts stopping at the scribed line. Next the alternate tabs are bent out and at right angles as in detail B. Now the flange is cut and slipped over the remaining vertical tabs, which are finally bent outward over the flange as in detail C. The finished job is shown in detail D. For added strength the tabs may be sweat-soldered.

Fig. 10 details various types of locking seams and typical soldered seams that are commonly used in joining sheet metals. Most of these can be formed on a bar folder, Fig. 21. Of course, the seams are not shown as they will appear when completed. They are shown open, or unlocked, to indicate the relationship of the folded edges. Some of the seams must be sweat-soldered, of course. While most of these bends are made by machine, some can be made easily by hand with the simplest tools. You will find these seams on various types of metal containers, in sheet-metal duct work, furnace plenums—anywhere sheet-metal parts are to be corner-joined or in some cases joined end to end.

Figs. 17, 18 and 20 picture a hand-powered unit known in tinshops as a rotary machine. It is supplied with interchangeable rolls and can be set up quickly to do crimping, beading, wiring, burring, and a number of other related operations. The machines generally are of two types,



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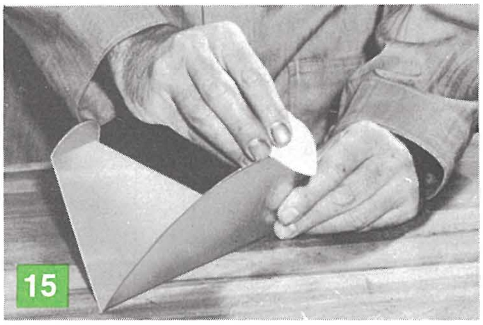

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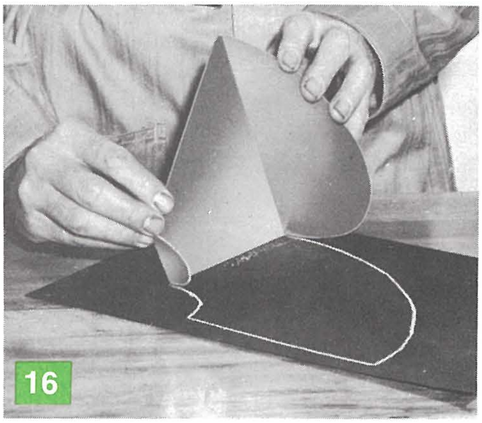

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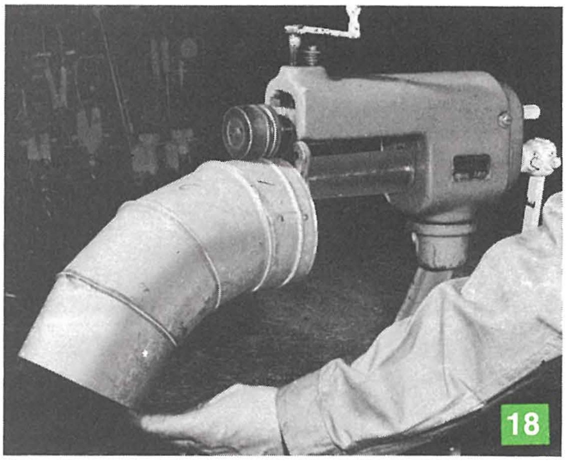
17

A STANDARD rotary machine is regular equipment in most sheet-metal shops. Here an edge is wired.


18

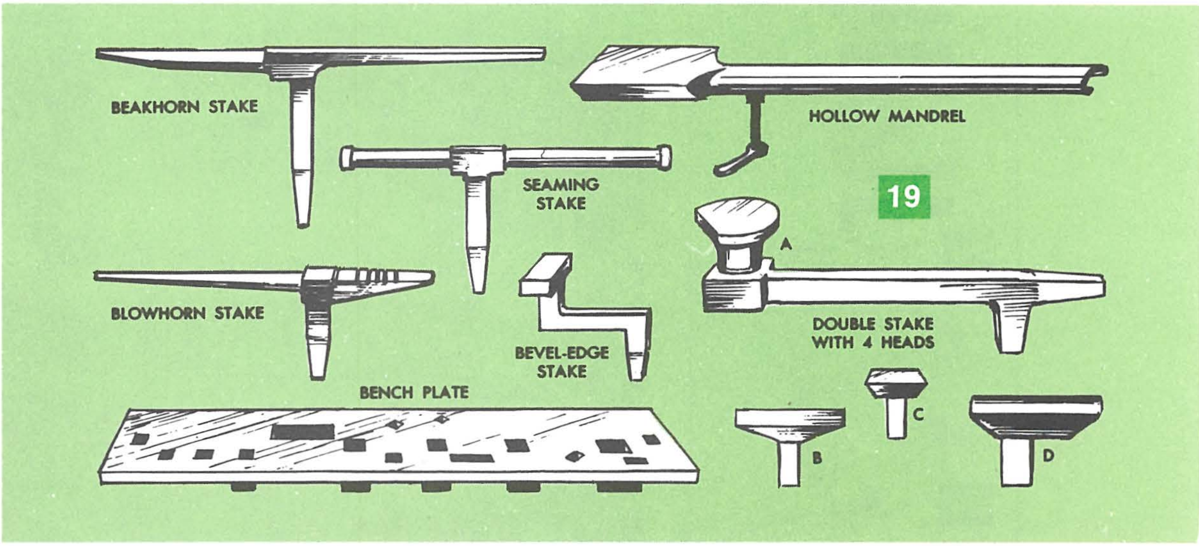
THIS ROTARY machine has a deep throat. Here a bead is being rolled on a smoke-pipe elbow.

the standard unit, Fig. 17 and the deep-throated unit, Figs. 18 and 20. A wiring operation is pictured in Fig. 17 and beading and crimping operations in Figs. 18 and 20.

In the well-equipped commercial shops and also in school shops you'll probably find an assortment of stakes and a bench plate. Fig. 19 illustrates only a few of the many types of stakes available for various types of sheet-metal work at the bench. One that is quite common, is the double stake, supplied with at least four heads, A, B, C, and D. Light sheet metals are worked on stakes and hollow mandrels.

Fig. 22 shows how the single hemmed edge is formed on a bar-type folding machine, Fig. 21. Fig. 23, details A, B and C, show the forming of a double-hemmed edge. In one method of making a grooved seam by hand, the locks on the two pieces of metal are folded and hooked together and the seam closed with a hand grooving tool, Fig. 24. The seam is then flattened with a wood mallet. The seaming tool, Fig. 25, enables one to do a better job of working a seam. It comes in widths up to 6 in. or more and facilitates making a sharp, clean bend. It is adjustable for depth, or reach, which determines the distance from the edge the bend is made.

Cylindrical forms can be made by working the metal over a hollow mandrel with a mallet, Fig. 19, or with a slip-roll former, Fig. 26. Straight cuts in the light sheet metals of 22 ga. and thinner are easily made with tin snips of the regular pattern, Fig. 25. For making short-radius circular cuts in from an edge you'll need the hawk's-bill snips. For intricate patterns involving curved cuts of medium radius you use what are known as pocket circular snips (not illustrated). Aviation snips, Fig. 25, come right and left and in combination and are designed for intricate work on light sheet metals.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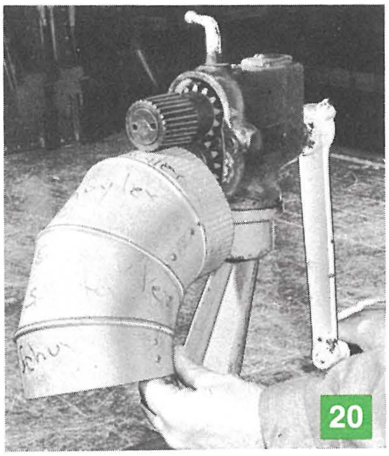

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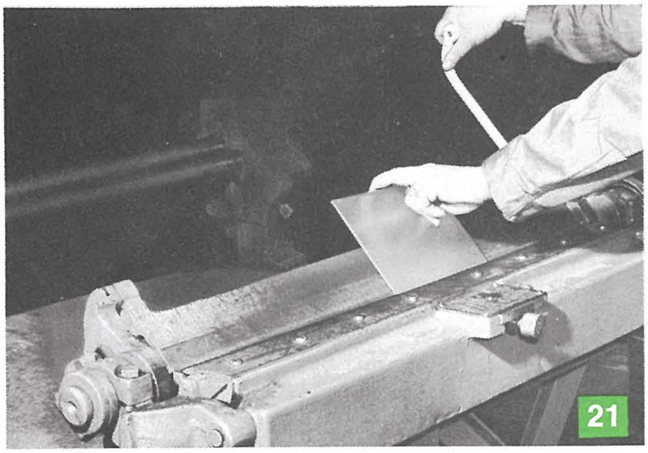
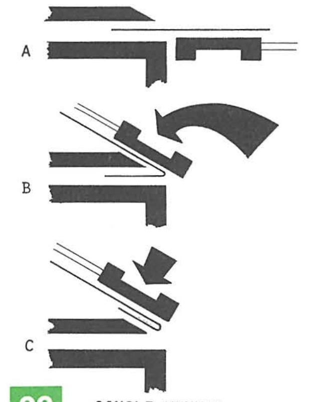
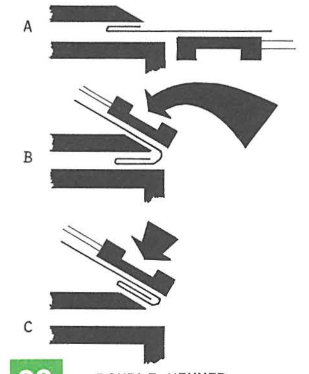


21

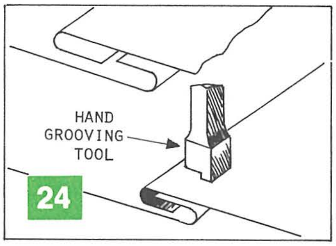
working sheet metal, continued



22 SINGLE HEMMED EDGE



23 DOUBLE HEMMED EDGE



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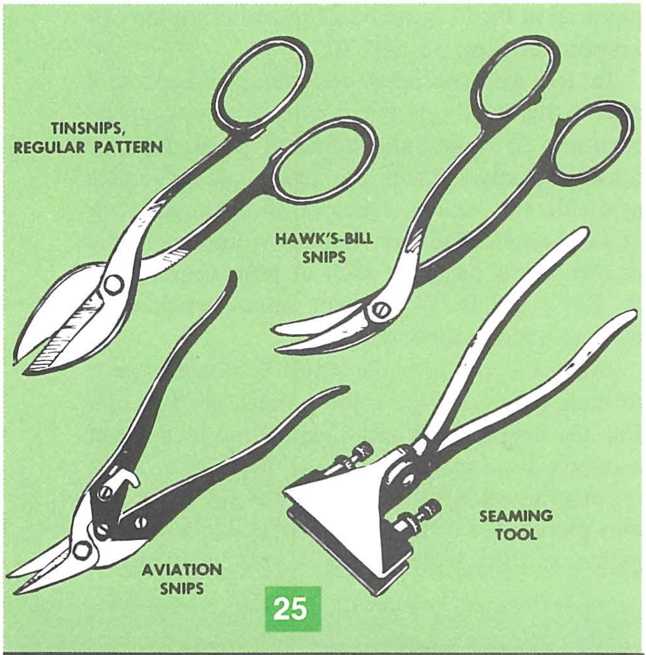

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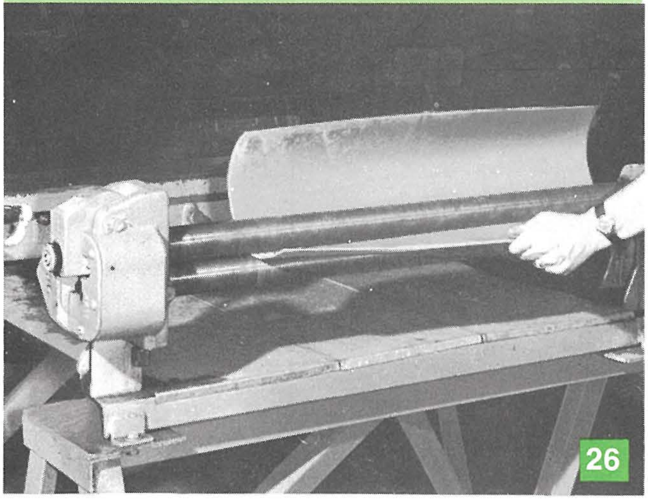

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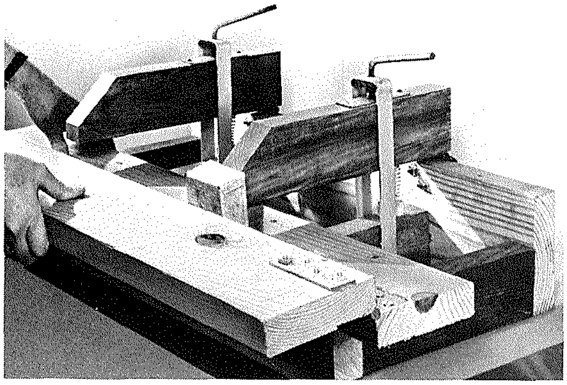
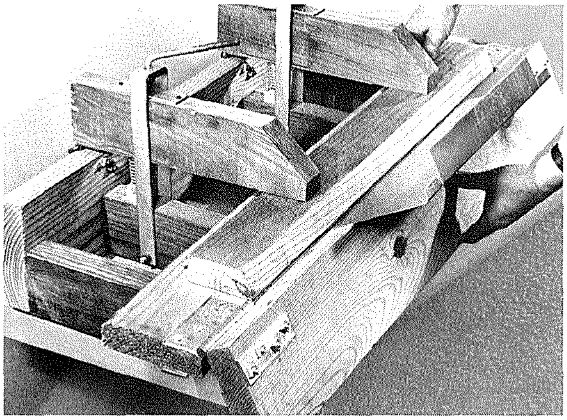


THE SHEET-METAL BRAKE, made of standard-size lumber, handles up to 26-gauge metal.



LONG PIECES OF METAL are as easy to bend as smaller ones with this homemade brake. You simply change the pressure foot.

▩ NEAT right-angle bends and flat folds are easy to make with this simple, benchtop, sheet-metal brake. The metal is inserted under the pressure plate, the two handles are tightened and the hinged forming bar across the front is brought up to make the desired degree of bend. To flatfold an edge, you first bring the forming bar all the way up and against the beveled pressure plate; then the work is removed, flipped over and the bend is squeezed flat.

The brake is made mostly of wood of standard lumberyard sizes. Nuts, which are sweat-soldered in place, provide the tapped holes for each threaded handle, and the yokes are bent from strap iron to straddle the two hinged pressure arms. A compression spring under each arm raises the arms automatically when its handle is backed off.

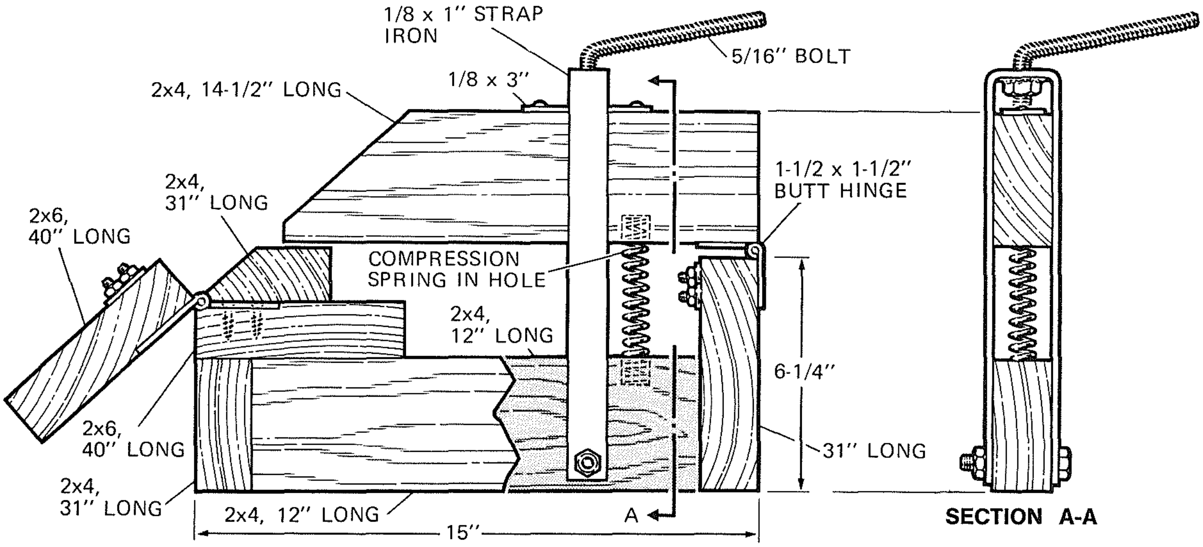
To bend a metal box, the trick is to bend two opposite sides using the regular pressure plate. Then a special pressure plate is cut to fit the inside width of the box and only one pressure arm is used to hold the plate while making the bend. You can fashion boxes as small as 3x4 in.

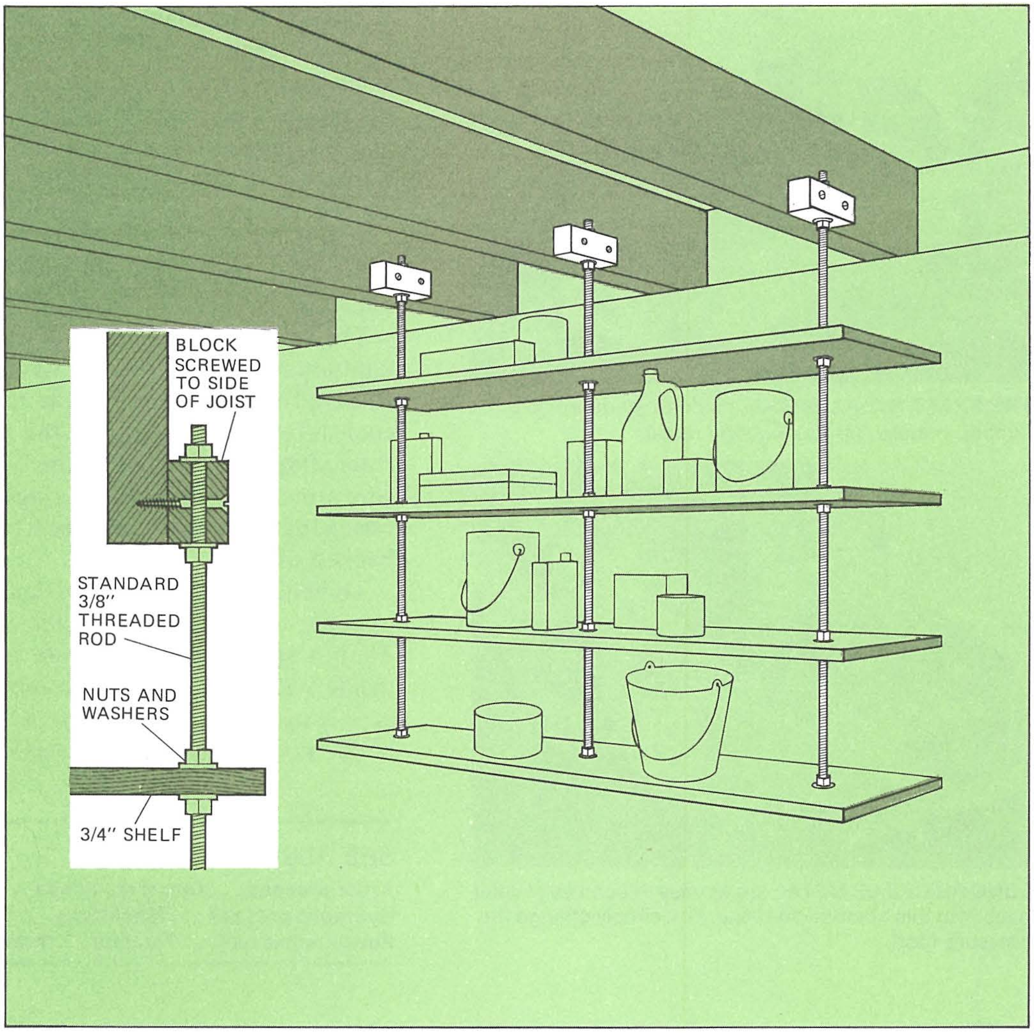
SEE ALSO

Arbor presses . . . Cutoff machines . . .
Hydraulic presses . . . Machining . . . Metal casting . . .
Power hacksaws . . . Torches . . . Tubing, metal

Sheet-metal brake you make of wood

By RAY M. GATES





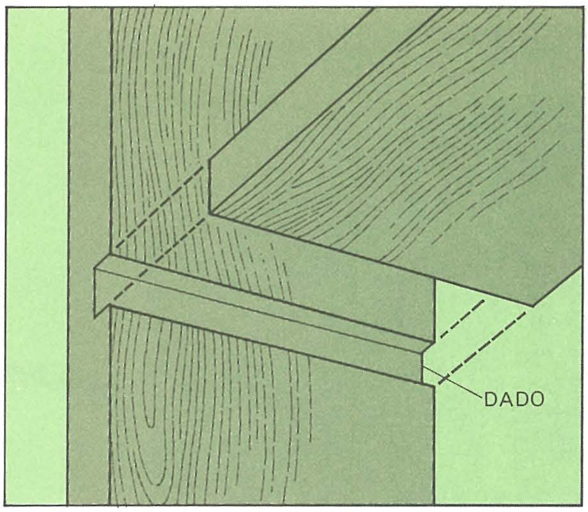
How to put up shelves that stay up

■ SHELVES CAN MEAN the difference between order and disorder in the basement, attic or garage, and they're something you can't have too many of for holding such things as cans of leftover paint, garden sprays and insecticides, balls, mitts and bats, clippers and shears, Christmas decorations, luggage, tools and boots.

There are about as many ways to support shelves as there are things to store. Shown on the facing page are six of the more common ways for installing them between end uprights or fastening them to walls or studs. All arrangements will hold a considerable load without giving way.

A novel way to hang shelves is shown above: Two or more boards are suspended from a series of threaded rods that pass through holes in the boards and wood blocks screwed to the basement joists.

SEE ALSO
Basement remodeling . . . Bookcases . . .
Fasteners . . . Garage remodeling . . .
Storage ideas . . . Storage walls . . . Wall shelves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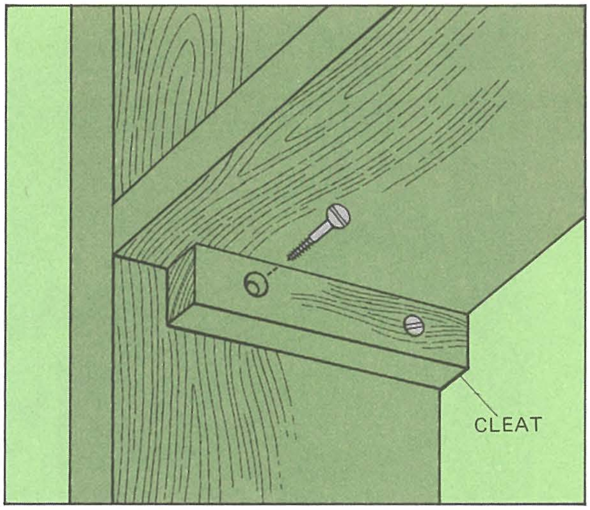
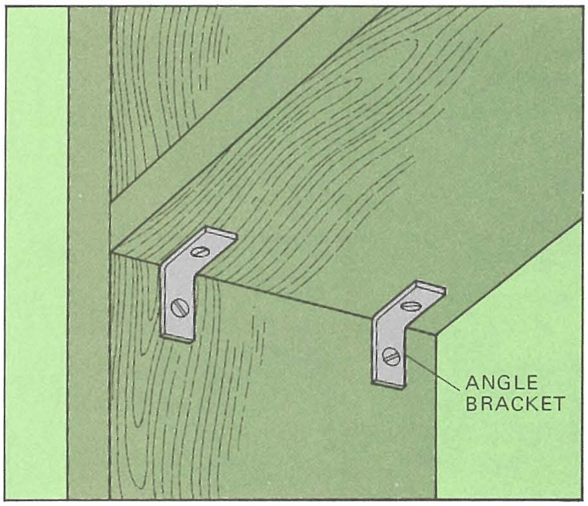
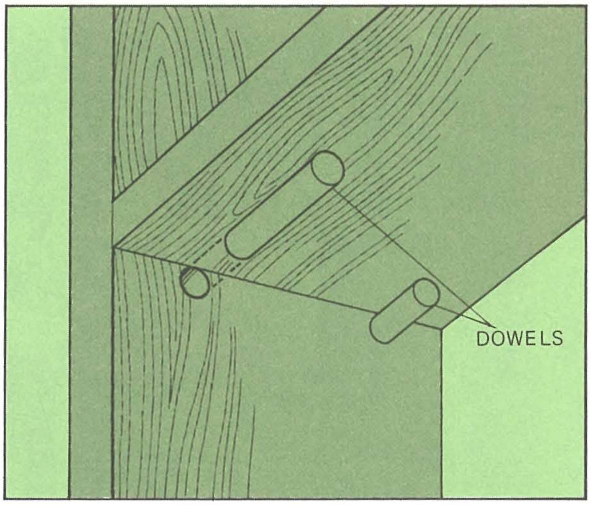
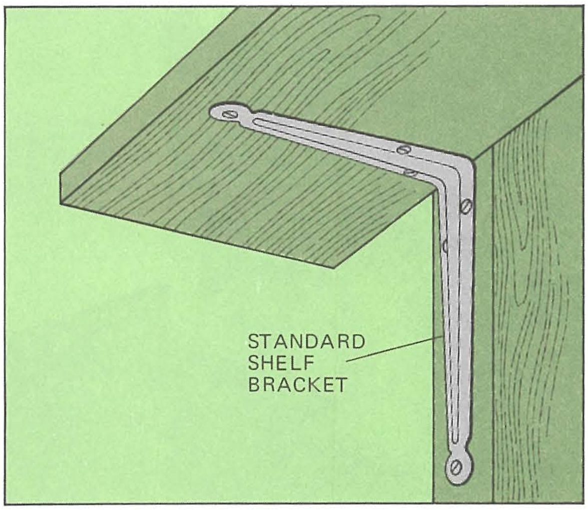

CLEAT


ANGLE
BRACKET


DOWELS


STANDARD
SHELF
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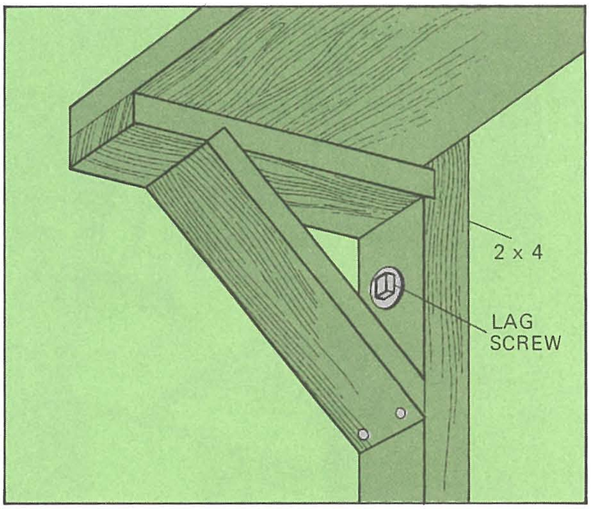
2 x 4
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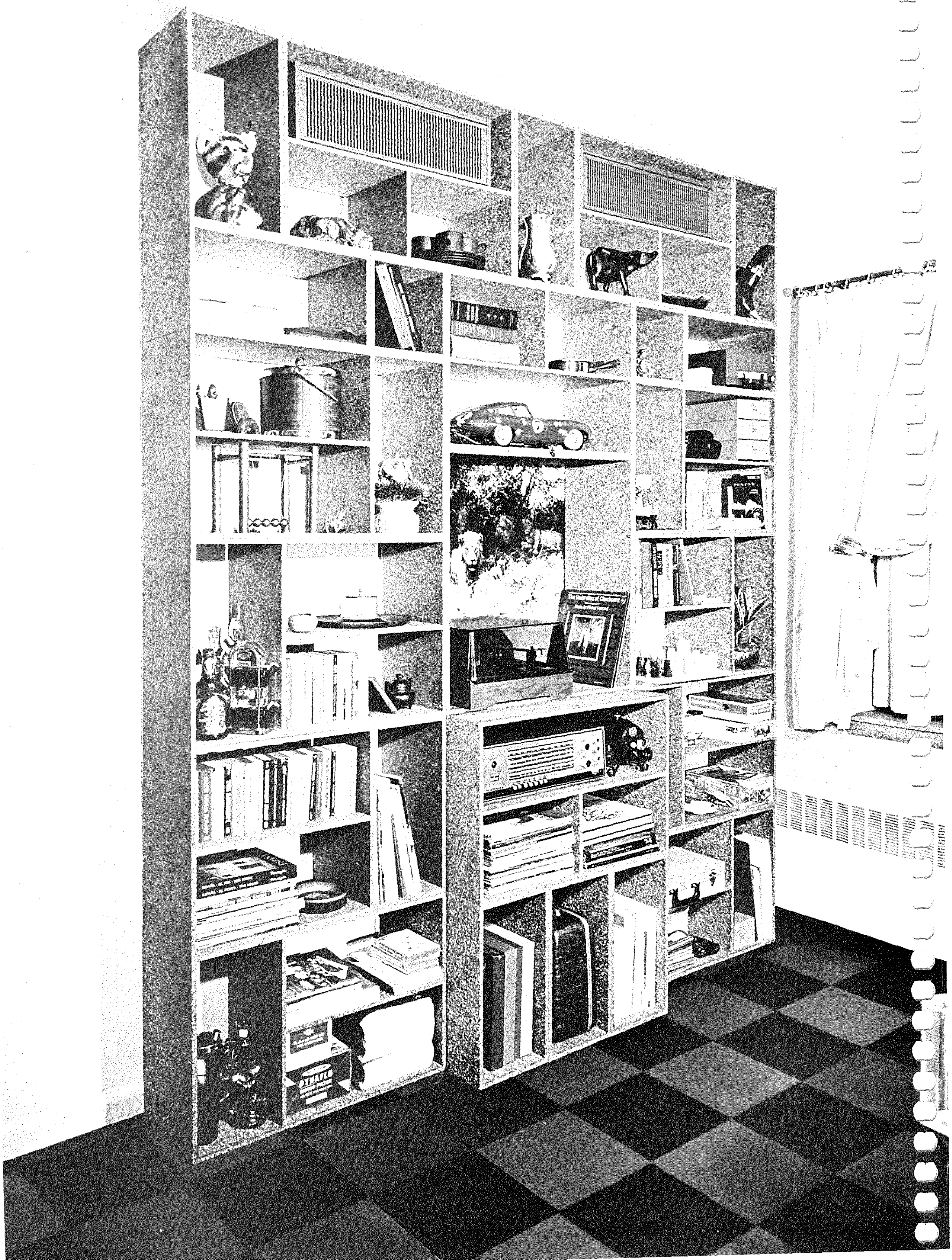
SCREW



Make shelves in modules for stackability

By LEONARD E. SABAL

SIMPLE SOLUTIONS to the problem of inadequate storage shelves often look simple—and ugly. Not so with this novel 1-2-3 system of shelf modules, however, especially as it displays a myriad of miscellaneous items while keeping them out of the way.

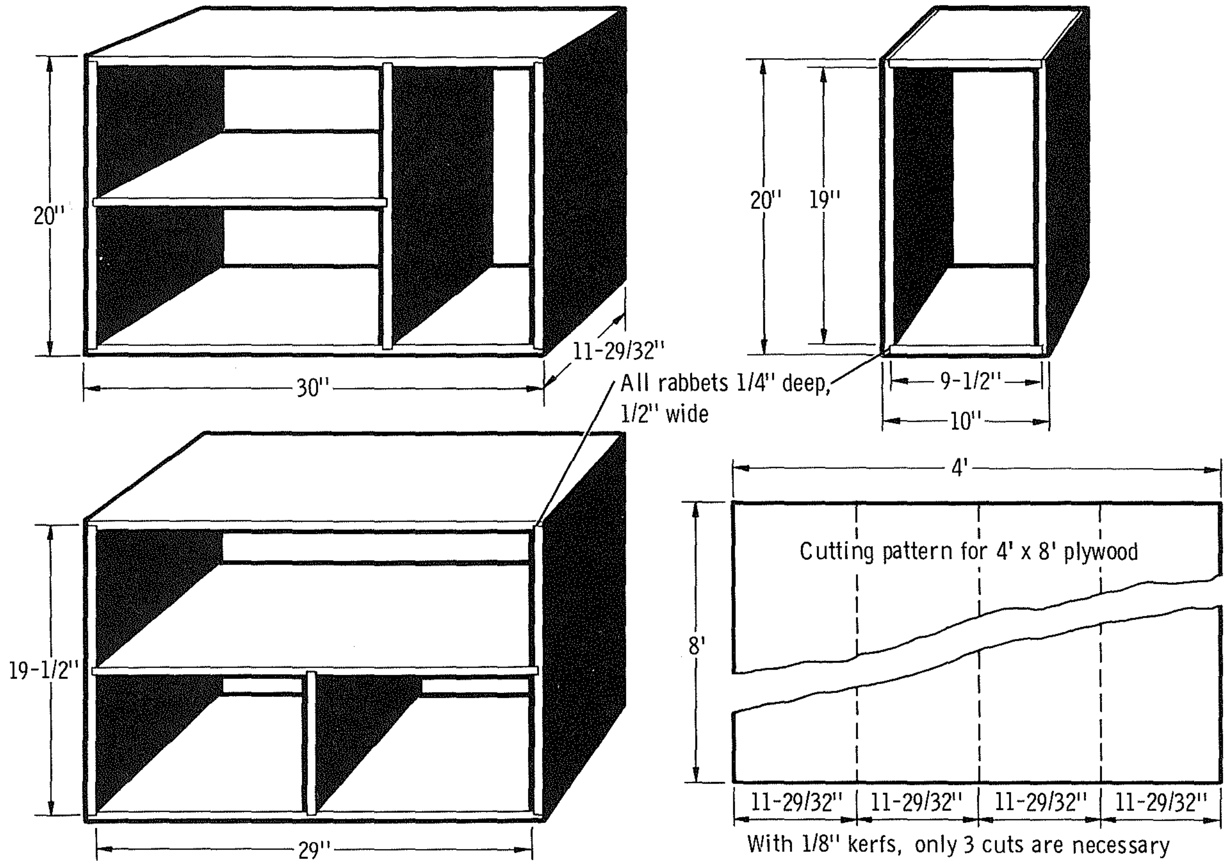
The 1-2-3 concept means simply that the three basic modules are built in proportions or multiples of 2 and 3. This means that the width of the smallest module shown below, for example, is one-third the width of the larger modules; while its height is two-thirds the width of the larger modules, and also equal to the height of the large units. Thus, it's possible to stack three of the small units side-by-side on top of a larger unit, or stack two small units on top of the large unit and then add a small module set on end.

The biggest single advantage of the system, however, lies in its flexibility—for with individual stacking modules such as these, you can vary the arrangement at any time, and also make other modules to suit special requirements. Thus, the four bottom modules in the center of this arrangement were made 18 in. deep to accommodate records and stero equipment, while a 30 x 30 module and two 10 x 10s were needed to complete the system.

It's extremely important to make certain the modules are square and to use a good grade of ½-in. exterior plywood to eliminate the chances of eventual warpage. Finally, since your requirements will probably mean some deviation from the layout shown, make sure you plot your desired arrangement carefully to contain the number of modules you'll need.

SEE ALSO

Bookcases . . . Cabinet furniture . . . Hi-fi centers . . . Modular furniture . . . Storage ideas . . . Storage walls . . . Stowaway furniture . . . Wall shelves


20"
30"
11-29/32"
All rabbets 1/4" deep, 1/2" wide
20"
19"
9-1/2"
10"
19-1/2"
29"
4'
8'
Cutting pattern for 4' x 8' plywood
11-29/32"
11-29/32"
11-29/32"
11-29/32"
With 1/8" kerfs, only 3 cuts are necessary

A handsome cover-up for utility shelving

By CRAIG WILSON

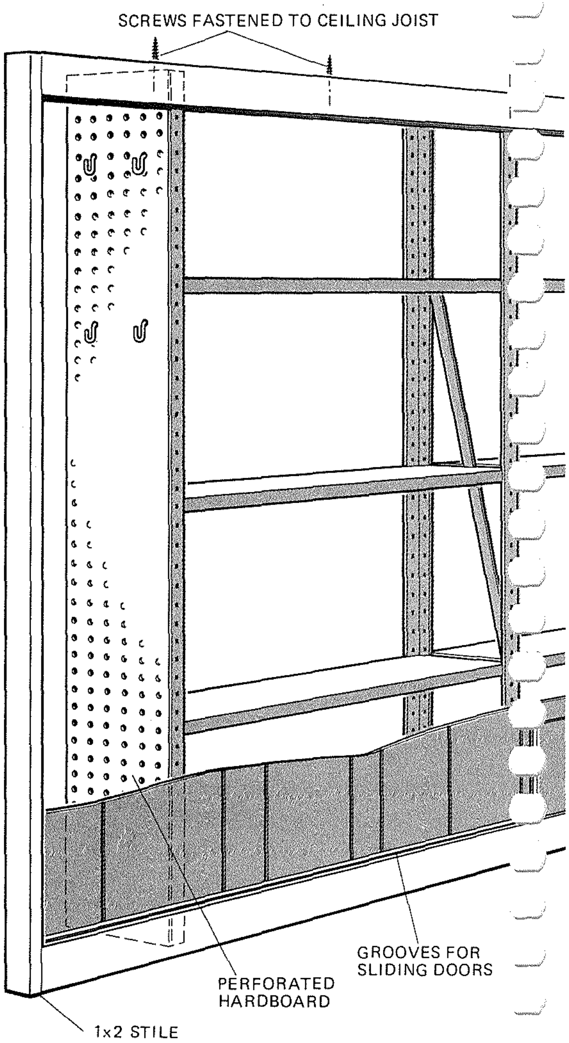
▨ UTILITY SHELVING is functional but not very pretty. If you use your basement for recreation as well as storage, or if you'd just like a neater looking garage, you want those cluttered shelves out of sight. I covered mine up inexpensively with a few sheets of prefinished ⅛-in. plywood paneling.

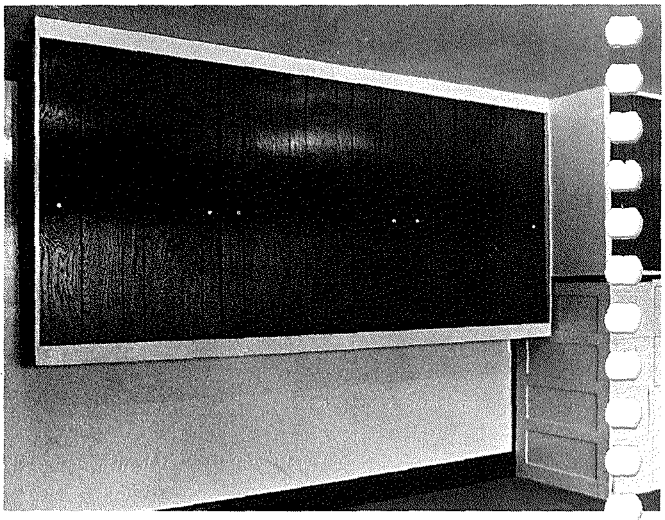
Panel doors slide in double grooves in kiln-dried 2x4 rails; it's important that the lumber you buy for these rails is straight. Grooves are made with a router or cut on a table saw (or you can have this step done at the lumberyard.) Shelving must be securely fastened to the wall. Fasten the rails to shelf uprights and to ceiling joists, where possible, with wood screws. The rails must be level; if shelves were made inaccurately, shims may be necessary. Vertical 1x2 end strips are fastened with glue and finishing nails. Make the framework wider than the shelves, close the sides in with perforated hardboard, and you'll have extra space for hanging storage. Panels are cut ⅜ in. shorter than the distance between bottom of lower groove and top of upper groove; cut a test strip to be sure of this dimension. Cut wide enough to allow at least 1-in. overlap between panels; bowing will be less likely if grain is vertical.

After the framework has been sanded, primed and painted (with gloss enamel for easy cleaning), bottom grooves are rubbed with beeswax to help panels slide smoothly. To dress up panel edges, glue on ⅛-in. plastic report-cover spines. These are sold in a variety of colors by office-supply outlets. Spines that will fit ¼-in. paneling are also available.

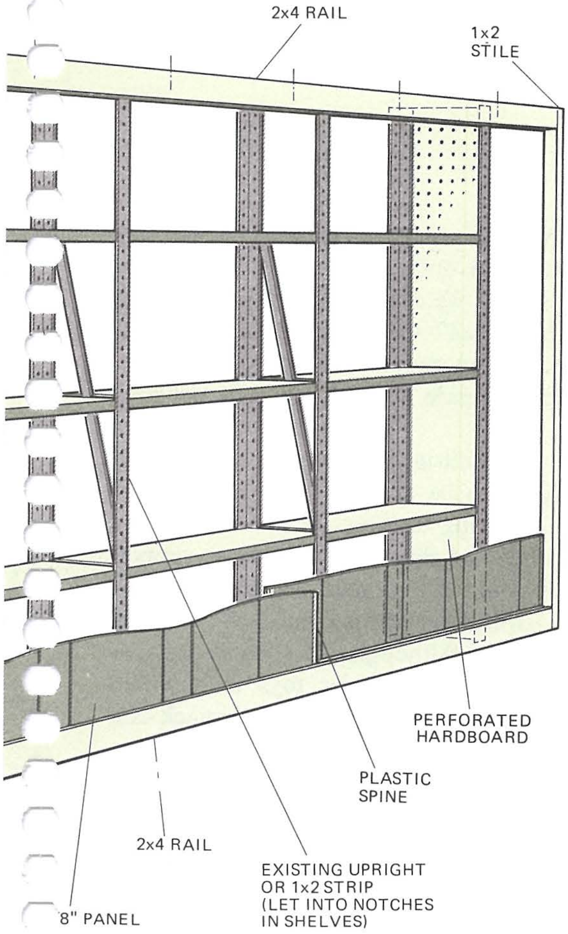
SEE ALSO

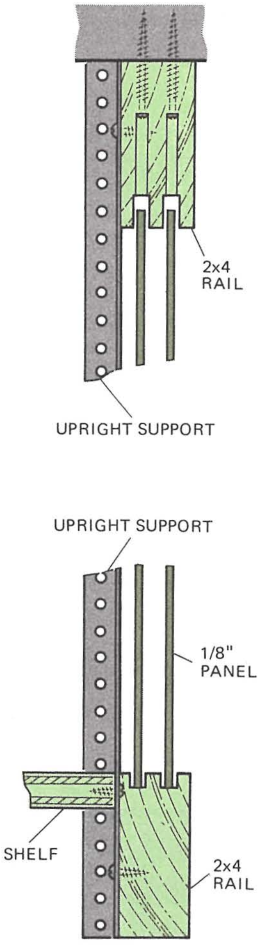
Basement remodeling . . . Family rooms . . . Fasteners . . . Garage remodeling . . . Hardboard . . . Paneling, plywood . . . Storage ideas . . . Storage walls . . . Wall shelves



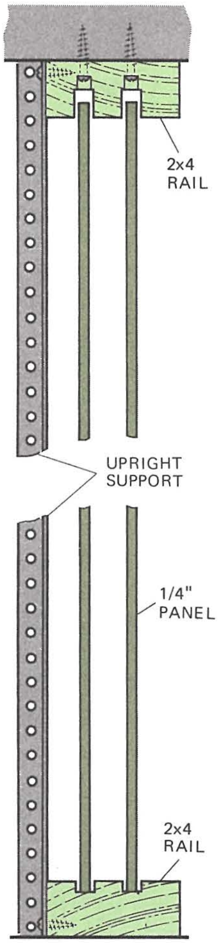


FRAMEWORK AND PANELING produce a handsome cabinet look. Recessed pulls are pressed into 1-in. holes in panels, should be above children's reach.

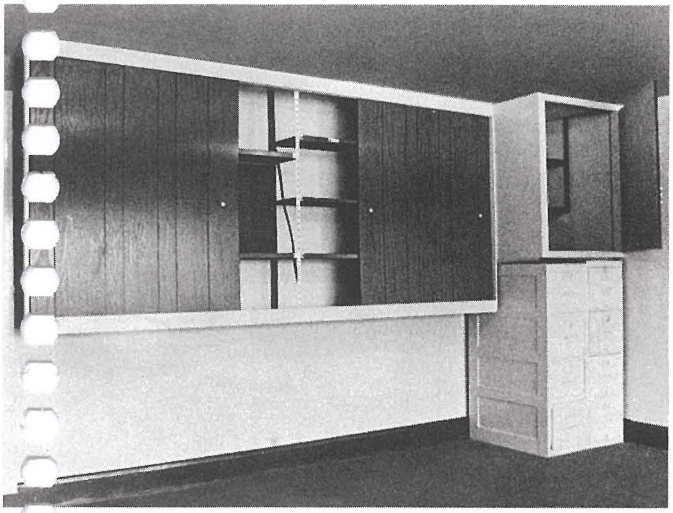




WALL UNIT

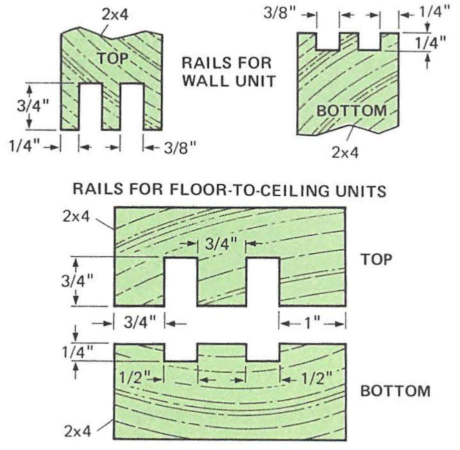


FLOOR-TO-CEILING UNIT



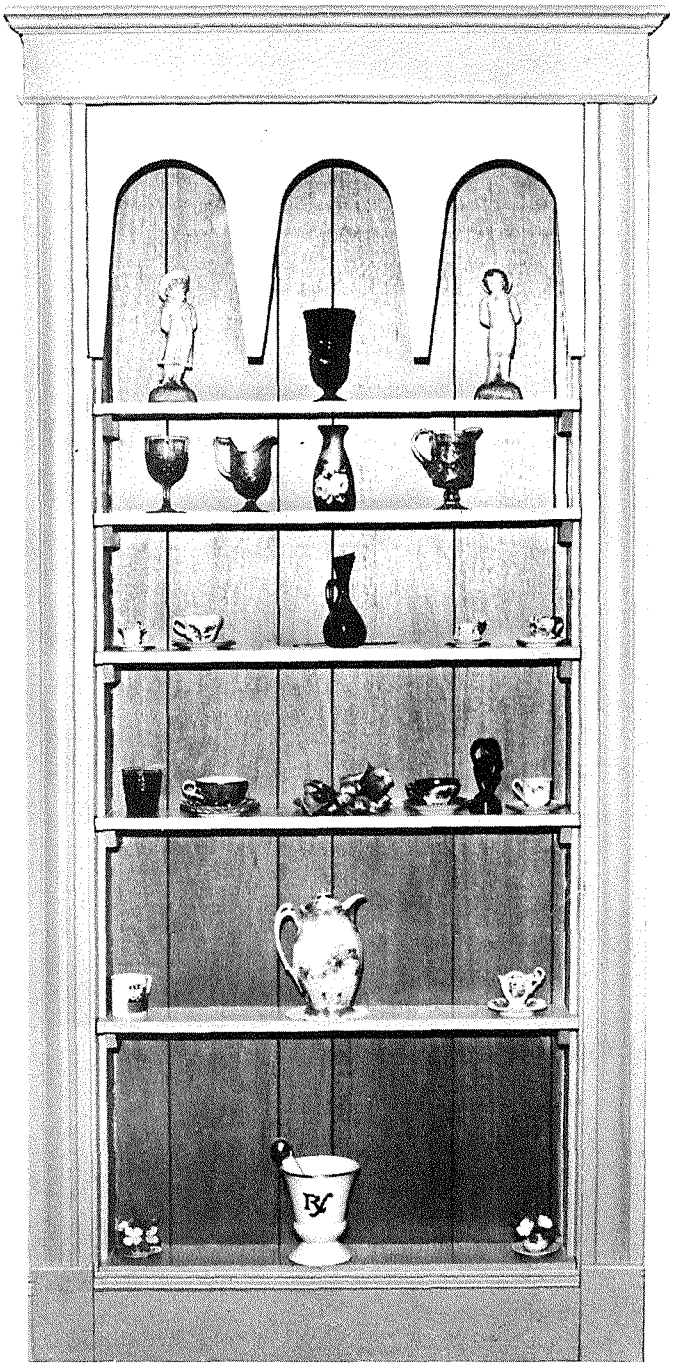
STORAGE SPACE inside is plentiful. Enclosure with a hinged door (paneling on ½-in. plywood) was made oversize for maximum space above the existing cabinet.

RAIL DIMENSIONS



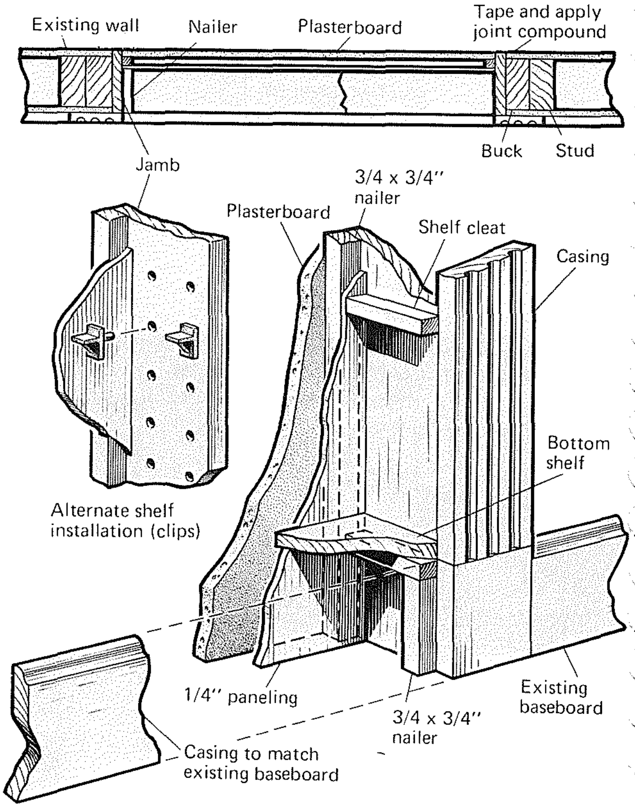
Shelves in a doorway

By S. L. SMAY



■ RECENTLY, when we removed the second-floor porch from our home, the question came up: What should we do with the space where the doorway had been? Our solution was to brick up the exterior (to match the existing finish) and use the space inside for an attractive whatnot shelf.

Though my built-in is on an exterior wall, the same shelves can be applied to an interior wall if you are planning to close up a doorway. For simplicity, I tacked cleats to the jambs to support the shelves, but, if you want a more sophisticated look, drill holes and use the shelf hardware as shown below. Although the shelves are narrow, they could be used for toys in a child's room or as a display area for a knickknack collector.



SEE ALSO

Bookcases . . . Doors . . . Entryways . . . Fasteners . . . Remodeling ideas . . . Storage walls . . . Wall shelves

Paint failure

Why does paint fail earlier on the south and west sides of my house?—S.M., Iowa.

What you describe is not so much paint "failure" as ordinary day-to-day exposure to the elements. Paint on all houses, in any clime, will always have a shorter life on the sides exposed to the sun. If you take a good look at your roof, you will find the same holds true for asphalt shingles. If you are trying to cut down on the painting chore, your best bets are to use a high-quality paint and to give some thought to applying an extra coat to the south and west walls.

Paint-stained concrete

I accidentally spilled about a pint of green paint on the concrete floor of my breezeway. Of course, I mopped it up but that green stain won't come off. What to do?—E.H., Tenn.

A wash-off type of paint remover just might do it. Here you have to watch the remover closely after applying it to see that it does not evaporate to the point where it won't wash off readily. After rinsing with clean water you may need a second and possibly a third application.

Or, you can make a thin paste by adding trisodium phosphate (about a double handful to the gallon of water), spread and cover with a cloth. Scrub away just before the stuff dries completely and rinse thoroughly.

As another alternative, you might use a wire brush or masonry abrasive disc chucked in your electric drill.

Concrete floor slant

I'm replacing a wooden porch floor with concrete and disagree with my contractor when he says ½-in. pitch, or slant, of the floor, will be sufficient for drainage. I think it should be at least 1¼ in. Who's right?—O.T., Mass.

Standard pitch for water runoff is ¼ in. per running foot. Thus, if your porch is 8 ft. wide, the high end—at the house—should be about 2 in. higher than the outboard edge. If your personal taste rules out this much pitch, I would not recommend a pitch of less than 1 in. For your peace of mind, "positive" water run-off is a must.

Don't shake that varnish!

Recently I was told never to shake a can containing varnish, but my informant did not know why. There must be a reason. What is it?—Y.M., Wash.

In a can containing varnish from which some of the contents have been used, air is entrapped when you replace the lid. If you shake the can prior to use, tiny air bubbles will form in the varnish and these will be picked up by the brush and laid on the surface being finished. As the varnish dries these form tiny flecks you can feel when you pass a finger over the surface. Always stir—never shake—varnish.

'Splicing' carpet

My carpet dealer says that my room and a small, narrow hallway are too wide for one standard width of carpet and too narrow for the next larger width; and that he can save me money by splicing on a strip to the required size. Can he make an invisible or nearly invisible splice? He insists he can but I'm doubtful.—Benjamin Ord, Alton, Ill.

Experienced carpet installers can splice, or patch, wall-to-wall carpeting in looped, sheared or shag texture so skillfully that you'd never guess it had been done. I would assume the dealer is thinking about a saving of waste material as well as money.

The floor over which the carpet is to be laid should be in good condition, and you should insist that your dealer renail the floor all over to catch any developing squeaks while you have the chance. I'm also assuming that the left-over strip from the room is to be used to patch out the carpeting in the hallway.

Paint peeling from concrete

Poured-concrete foundation walls of my 10-year-old home were originally painted above ground. Last year I repainted them with latex. This has peeled off in large sheets from ground level to top of the concrete, leaving the original paint. Can you tell me why, and advise what I should do?—John Rutherford, Washington, D.C.

The original coat must have been an oil-based exterior paint. Latex-based paints do not always bond solidly to the smooth oil-paint surface. If the original coating is still in relatively good condition, adhering solidly to the concrete, I suggest that you scrape off all loose material with a wire brush, wash and rinse the surface, let it dry thoroughly and apply an oil-based masonry paint. If you want to use latex instead, prepare the surface by removing as much loose material as possible with the wire brush, then applying a surface conditioner such as Glidden's Y-40 Spred Spar Varnish mixed with naphtha or mineral spirits (follow directions appearing on the can) before painting. Sandblasting is an (expensive) alternative.

by W. Clyde Lammey

The challenge of modeling fine ships

By JAKE GRUBB

Here's how a master modeler creates magnificent miniatures of legendary sailing vessels—and how you can, too. In many cases it's possible to obtain and use the original plans. Modern tools, books, materials and parts speed the work without sacrificing authenticity

■ MAKING AN AUTHENTIC REPLICA of a mighty square rigger used to be considered beyond the skills of the average do-it-yourselfer, requiring expert know-how, specialized tools and massive amounts of time and patience. Time and patience are still requisites, but beyond these the task is not necessarily as awesome as it might seem. Authentic construction plans are available from a variety of sources. Books, tools, materials and even many ready-made parts can be obtained at hobby shops. Modern power tools make the job easier than ever, speeding once laborious, time-consuming hand operations.

Recreating in miniature the majesty of an ancient sailing ship is a rewarding challenge—filled with fun and excitement—that any hobbyist can master, says veteran modelmaker Ed Sims of Laguna Beach, CA, a man who for 27 years has made his living duplicating legendary vessels in precise scaled-down detail. The first thing to do, he says, is obtain plans for the ship of your choice, often easier than you may imagine. This is done by contacting the proper historical institution. If the ship is American, Sims writes directly to the Smithsonian Institution in Washington, DC. "Specify the ship you are looking for," he advises, "and the Institution will likely have the original plans or duplicates on file. They will send you copies for a nominal fee—one or two dollars. If they can't supply the plans you want, they will often refer you to a source that can."

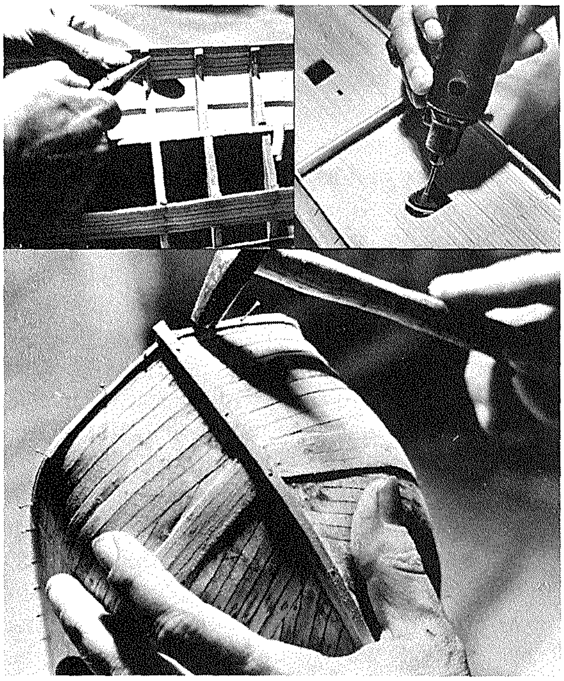
good sources: museums

Other sources for plans are hobby shops and maritime museums. Most hobby shops stock or can order plans for well-known historical vessels. If the ship you want is of foreign origin or an obscure design, your best bet may be a maritime museum. "There are 82 national maritime museums throughout the world," says Sims. "You start by finding out where the ship you want was originally built, then you write the national maritime museum of that country. They will either have the plans or suggest other sources." Sims recommends the museums of Great Britain, Paris, Rotterdam and Barcelona as being most helpful.

Plans will probably be in ⅛ or $^3/_{16}$-inch scale. Beware of a larger scale or you may find yourself with a model the size of your living room on your hands, Sims warns.

Tools required for ship modeling are basically simple, says Sims: a pair of needle-nosed pliers, cuticle scissors for fine cutting, an X-Acto knife with No. 1 blade, X-Acto modeler's chisels, tweezers, a $^1/_{32}$-inch-scale ruler, fine sandpaper and a miniature electric hand drill or hand grinder of the Dremel type. Sims uses a hobbyist's jigsaw for cutting out ribs, keels and other parts demanding precise accuracy. He also uses a small bench sander for shaping and finishing. If necessary, a coping saw can be substituted for the powered jigsaw and hand sanding for the bench sander.

Working from original plans is relatively easy if you take them a step at a time and don't allow yourself to become confused by the mass of intricate detail. Take your time and study each part before attempting to reproduce it. Wherever possible, obtain pictures of the ship you're modeling as these will serve as an additional aid in deciphering the plans.



MIGHTY THREE-MASTED SQUARE RIGGER, shown in all her ornate glory on facing page, begins to take shape above. First step is planking hull. Thin wood strips, watersoaked to make them pliable, are glued and tacked on with brass pins as temporary fasteners. After glue sets, pins are removed with long-nosed pliers (top left) and holes "pegged." At top right, square holes for masts are formed in deck with tiny disc sander.

SEE ALSO

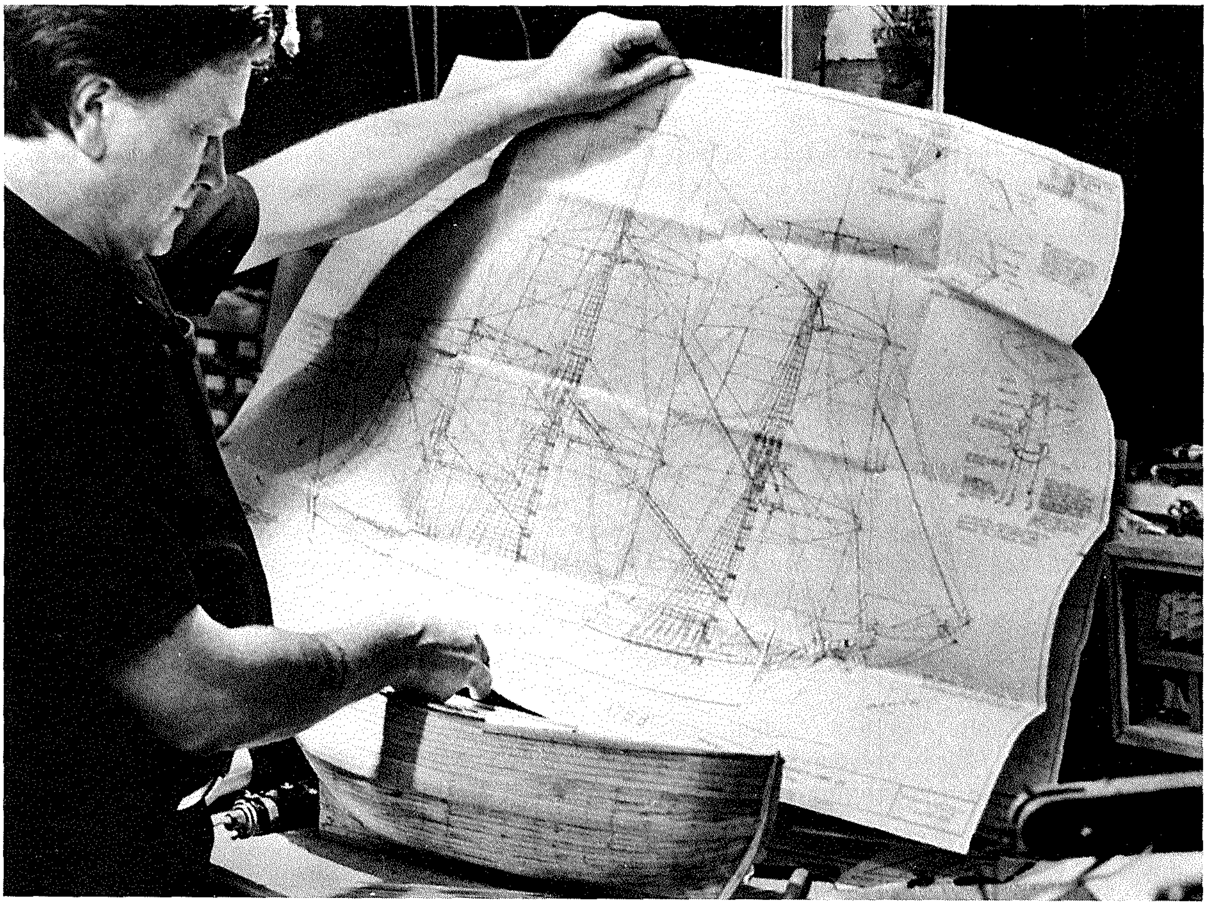
Airplane models . . . Cannon models . . .
Hobby centers . . . Jeweler's saws . . .
Metal casting . . . Modelmaking

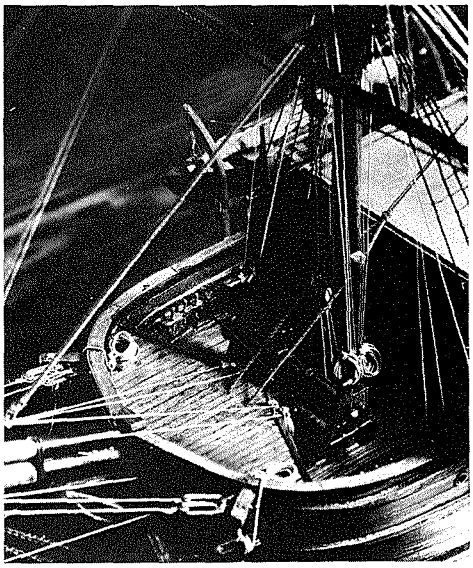
First step in the building process is to make precise tracings of the ribs and keel. These are then cut into templates, laid on ⅛-inch-thick plywood and traced again to produce the actual parts. The ribs and keel are cut out with a jigsaw or coping saw and matched against the original plan for accuracy.

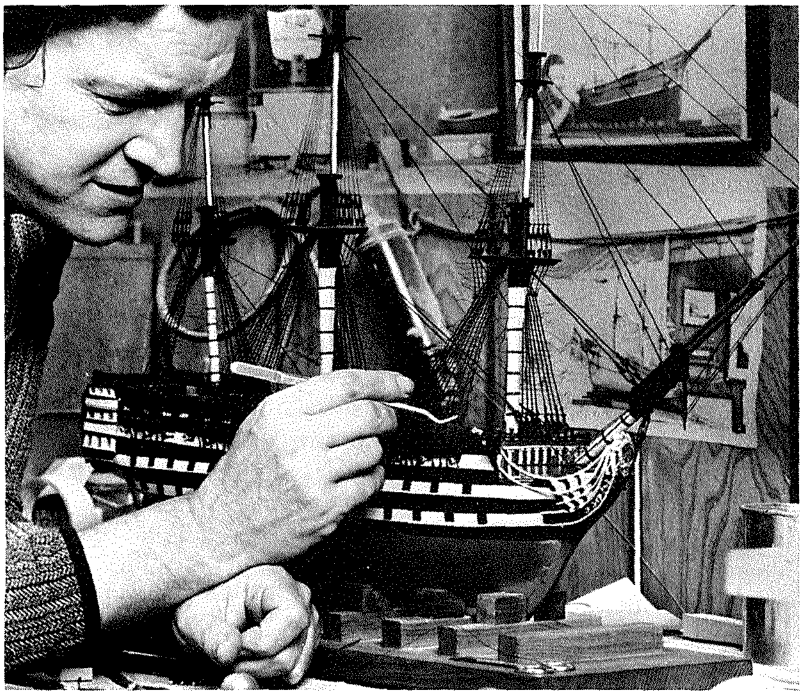
Gluing begins when the keel and all ribs are cut. The ribs are slotted and glued along the keel at intervals specified by the plans. The next step is to add planking. The planks are usually ¼ by $^1/_{16}$-inch spruce or bass wood, purchased from a hobby shop. These fine strips are attractive in color and grain and, because of their flexibility, are easy to apply to the curving contours of a wooden ship hull. The planks are treated in two stages. First the edges are painted black so that when the strips are butted together they're separated by thin black lines that simulate the caulking between teak planks in traditional sailing ships. A quick way to do this is to bunch the strips together in a stack and spray all the edges at one time with black lacquer.

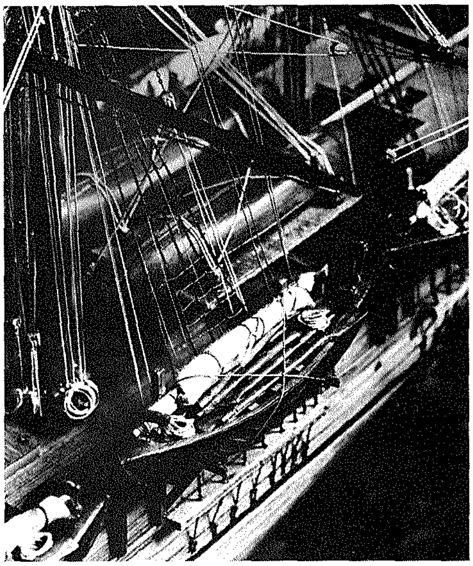
Stage two is to separate the planks, let the paint dry, then soak them in a tub of water for two or three days. Soaking makes the wood pliable and easy to work. You begin planking by first laying a strip of wood in a straight line down one side of the hull, positioning it halfway between topside and keel. This gives you a straight starting point for laying up the remaining planks. You glue the plank at each point where it meets a rib, using a water-soluble cement. At the same time, you tack the plank in place with tiny ½-inch brass pins. These hold the plank until the glue dries. After the first strip has been applied, others are added alternately on each side until the entire half of the hull is covered. At the bow and stern, the ends of the strips are carefully trimmed. Then the opposite side of the hull is planked in the same way. When all planks are applied, the small brass pins are removed with needle-nosed pliers, leaving holes which are then drilled out and filled with tiny doweling "pegs" to simulate the pegged planking used in real sailing ships.

AUTHENTIC PLANS of early sailing ships provide accurate data for superdetailed modeling. Copies of such originals are available at nominal cost from maritime museums and from historical institutions like the Smithsonian.

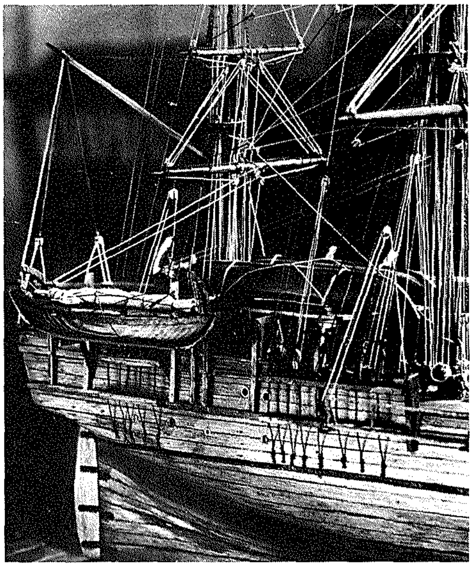


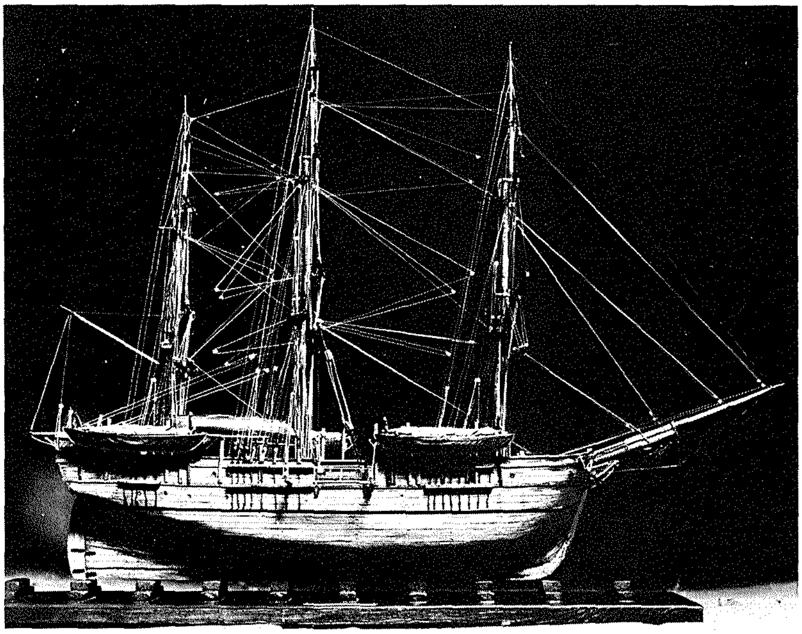






MASTER MODELMAKER ED SIMS (above) checks "ratlins" for proper tautness of rigging before putting finishing touches on a 17th-century British warship. Photos at left show fantastic detail and workmanship in masts, rigging and deck fittings that are typical of an authentic replica made from original ship's plans. Shown below is Sim's unique method of mounting his models. Instead of being held in a conventional cradle, the vessel sits on rows of wood blocks simulating heavy timbers, giving it the appearance of resting on ways ready for launching. Bolts that run through the keel hold it in place.





Careful hand sanding with very fine paper smooths and tapers the hull, removing minor flaws in the planking and adding the graceful, sweeping contour lines typical of traditional square riggers. Planking the deck comes next and is done in much the same way as the sides of the hull except that the job is simpler and faster because there are no intricate contours involved.

The hull is finished in several steps, depending on the effect and appearance desired. Sims starts with an overall coat of all-purpose sanding sealer, then usually follows this with an oil-base wood stain rubbed on with a soft cloth. In some cases, wood trim is highlighted with paint, depending on historical accuracy or builder preference. Finally, the hull is given a second application of sanding sealer; this time it serves as a varnish to produce a softly gleaming satin finish.

With the hull complete, the ship is now ready for a stand. In fashioning his stands, Sims uses an unusual method. Instead of the conventional cradle or flat base, he mounts his hulls between rows of small wood blocks fastened in turn to a plank. The blocks create the effect of a ship perched on ways ready to be launched.

Hull detail begins with deck components such as hatches, winches, cabins, windlasses, capstans and transom. Here is where the use of pictures becomes an important supplement to the plans. While the plans will give the physical dimensions of such deck details, they will not show how they really looked. Many of these are highly distinctive and decorative in design, and only pictures can give you a true feeling of their appearance. The miniature woodwork is all made by hand. Tiny cabin windows are cut out with X-Acto chisels, hatch covers are shaped from thin spruce, lifeboats are carved from solid pine and winches are built up from a number of tiny individual pieces.

The transom, often the most ornate part of the ship, is usually a highly intricate arrangement of windows and scrollwork. Here's where a few special tricks, developed over years of experience, can be a valuable aid to the beginning modeler. Sims has a unique way of making window panes, for example. In each small carved opening for a window, he merely dabs a tiny spot of transparent glue and lets it dry, forming a mottled pane of simulated glass. The result is amazingly realistic. For scrollwork and other textured effects, Sims uses liquid gesso, a surface-preparation material employed by artists for oil paintings. When the fast-drying gesso is applied in repeated coats with a fine brush, it builds up a thick, irregular base that, when stained, takes on the appearance of intricately carved wood.

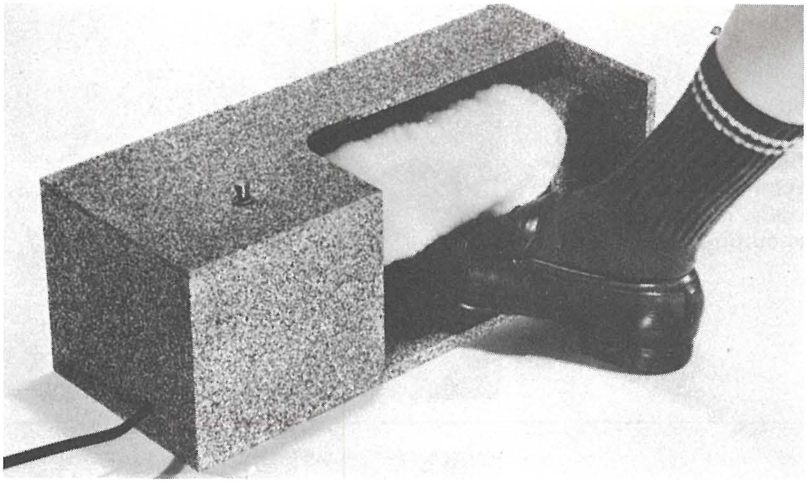
The technique can be used on figureheads, scrolls, flowers and other ornamental details. In fact, Sims often simply rough-cuts his designs, then works them over with gesso to achieve the final results—like modeling with clay, but in miniature.

Masts, yardarms, booms and bowsprits are all made from standard wood dowel stock. Sims selects dowel diameters to match the fattest portions shown on the plans, then tapers down the ends by eye. He does rough tapering on a bench sander and finishes up with hand sanding. Square holes for stepping masts are made by first drilling small round holes in the deck, then enlarging these into square openings with a disc sander chucked in a hand grinder.

"Rigging is a subject in itself," Sims explains. Before trying it, a beginning ship modeler should study the technique thoroughly from readily available published sources. For this, Sims recommends Harold Calahan's books on rigging for sailing ships, especially his volume entitled *Masts and Rigging*. This can be obtained at most libraries and bookstores.

"You begin with the running rigging—the white lines that control the sails—and work upward," advises Sims. "Once you get past the lower shrouds, the task is 75 percent complete." Sims uses white Irish linen thread in varying weights depending on the ship's size. The ratlins, or ladder-type side rigging, are also of Irish linen thread and are rubbed generously with beeswax to stiffen them. Sims warns against using synthetic nylon or rayon threads because they tend to stretch in time.

Miniature metal fittings such as cannons, pulleys, chains and anchors are available ready-made for nearly every purpose on a ship. These can be obtained at, or ordered through, most hobby shops. While such items *can* be handmade—and a perfectionist would insist that they be—Sims is willing to concede that they offer a handy way to avoid a lot of tedious work and are especially convenient for the beginner. In other words, it's no sin to add a few commercially made details if they'll improve the appearance of your handiwork. The important thing is the end result—and the thrill and satisfaction you'll get from turning out a masterpiece that's your very own from keel to crow's nest. And it's not all that hard, if you really want to do it.



Here's how to build your own electric shoe buffer. It's a simple project using only a few parts

Shine your shoes with a paint roller

By DAVID LORTON

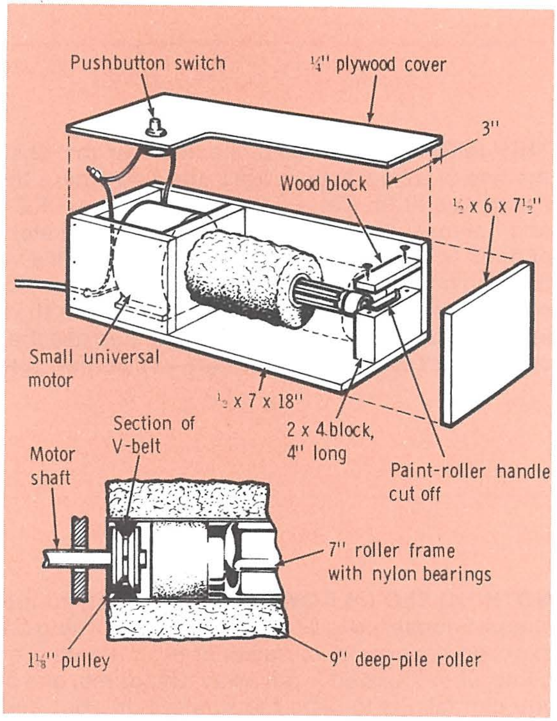
■ YOU STILL HAVE to apply the polish and rub it down, but this motor-driven shoe buffer takes all the rest of the work out of producing a high-luster shine.

All you need to build it is a small 110-v. motor, a 7-in. paint-roller frame with nylon bushings, a 9-in. deep-pile roller of the type used on stucco or concrete, plus a few other miscellaneous parts and the plywood to construct the box.

To link the motor to the paint roller, install a 1⅛-in. pulley on the motor shaft. This pulley will be slightly smaller than the inside diameter of the roller, so you'll have to cut a length of drive belt to wrap around the outside of the pulley and produce a snug press fit. The pulley can then provide direct friction drive to the roller from the motor.

To construct the bearing for the opposite end, cut the handle off the 7-in. paint-roller frame, leaving the small section perpendicular to the roller axis to use in mounting. This section is placed on the end block and clamped securely in place by means of a small wood cap strip which is attached to the block with a pair of screws.

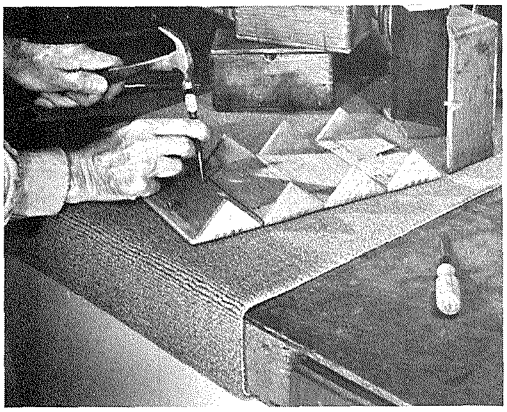
Make up the box and install the mechanical components inside. Use screws to attach the top, so that it can be removed easily if you should have to adjust or replace the roller or lubricate the shaft.



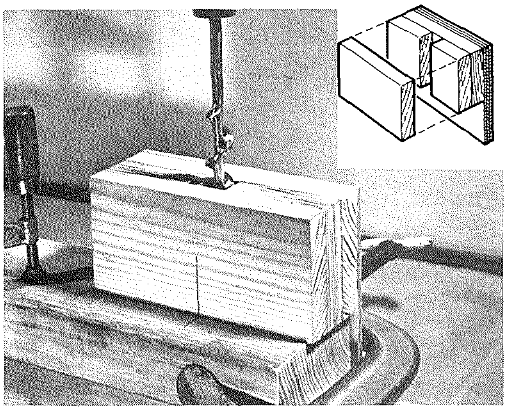
SEE ALSO

Motors, shop . . . Paint rollers . . . Shoe drawers

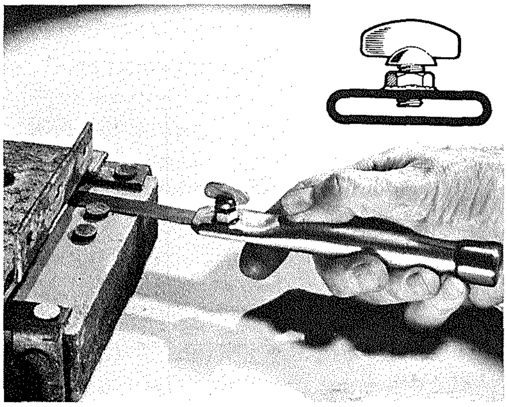
A SCRAP PIECE OF CARPETING tacked over part of your workbench top offers all sorts of advantages. For one, it acts as a protective pad to prevent finished surfaces from being scratched. Also, the rough texture will keep small parts from rolling off the bench. Finally, it makes an excellent work surface for any glass-cutting jobs in the shop.—*Frank Shore.*



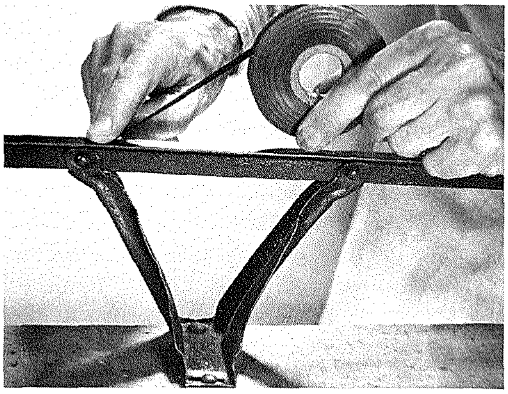
MADE FROM SCRAP stock, this simple jig is designed to guide the drill bit when you drill dowel holes. It allows you to drill in a plane perpendicular to the face of the work. Just cut the filler block sections to form a close-fitting square channel for the drill bit. The rear piece is clamped against the work. To aid in positioning, scribe a reference mark on the front of the rail block, locating it in line with the square guide hole and parallel to the hole's vertical axis.—*F. Louis Rush.*

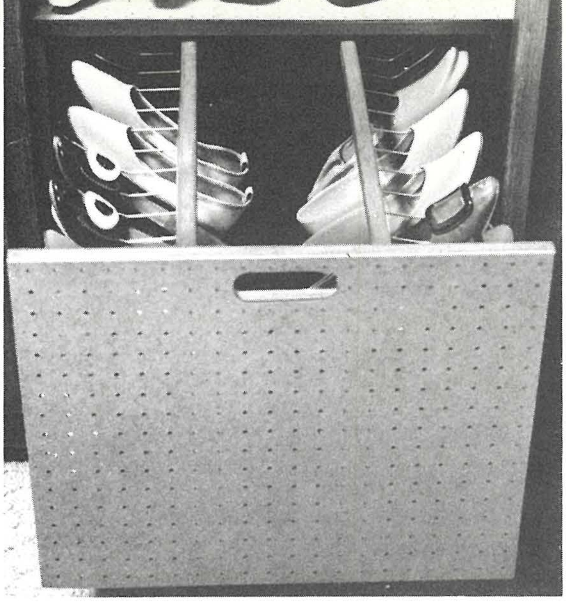


THIS IMPROVISED TOOL is a lifesaver for jobs requiring the use of a hacksaw in tight quarters where the regular handle won't fit. Cut a 6-in. length of ½-in.-dia. tubing and hammer one end almost flat, leaving a slot just wide enough to take the hacksaw blade. Next, drill a $^{5}/_{16}$-in. hole through one side of this flattened portion and solder a ¼-in. nut over the hole. Fit a ¼-in. thumbscrew in the nut, then insert the blade to the desired length and use the screw to clamp it securely in the handle.—*W. Herbert Neander.*



NOTHING SLOWS DOWN a sled like rusty runners, yet it's almost impossible to prevent rust from forming because the exposed bare metal surfaces of the runners are usually damp when the sled is put away. Of course, one precaution you can take is to wipe the runners dry, but this doesn't protect them from moisture in the air. A more efficient idea is to dry the runners, then cover them with two long strips of plastic tape. It's a simple solution, but it works.—*Glen Wilson.*





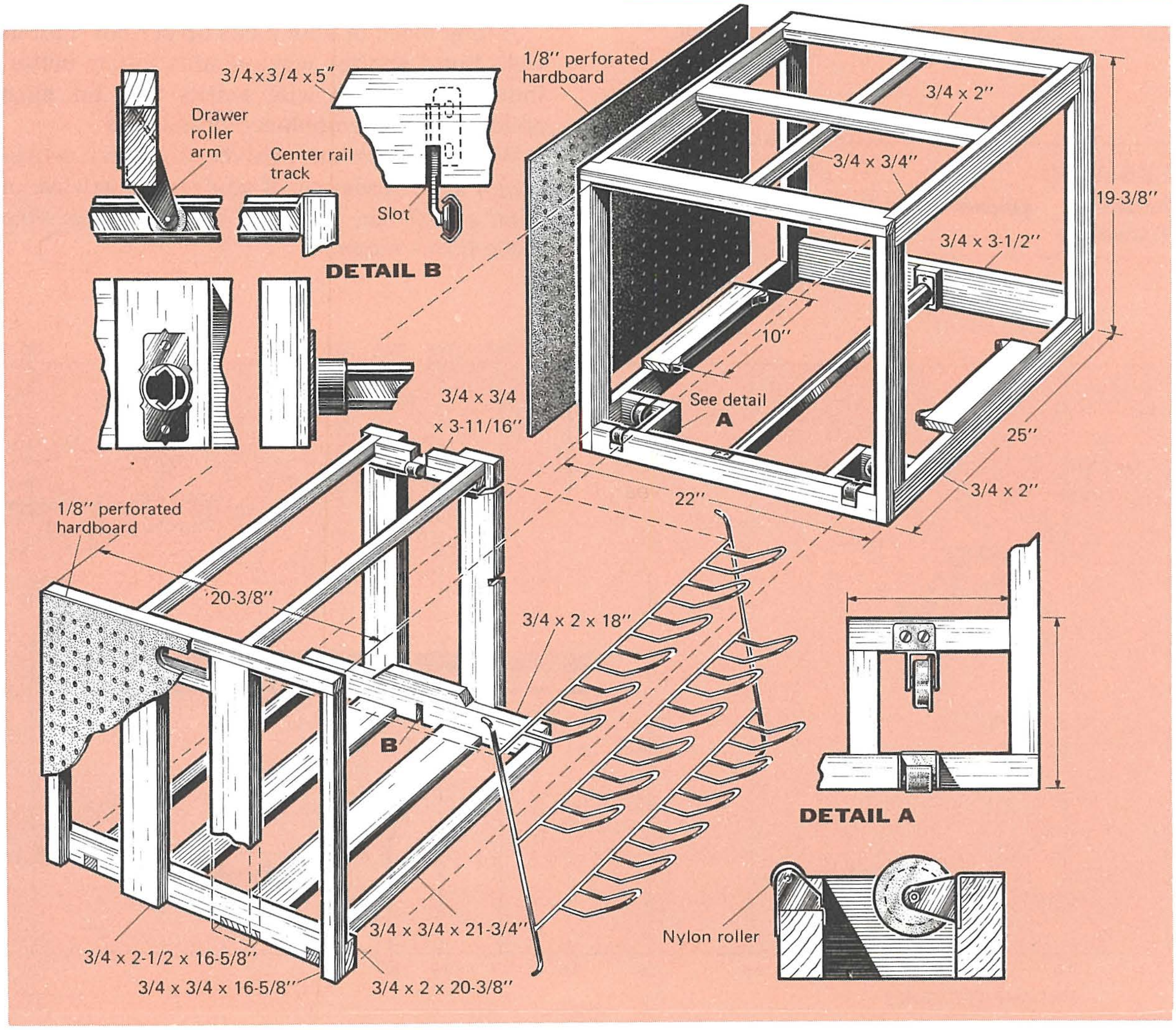
A roll-out shoe drawer

■ HOW MANY TIMES have you stumbled over your wife's shoes sticking out from under the bed, or opened a closet door to be greeted by an avalanche of dusty footwear? That's why I built this closet roll-out shoe drawer.

The drawer is designed to accommodate two common metal shoe racks. It rolls smoothly on a metal drawer track and seven nylon rollers. I cut off about 4 in. from the shoe-rack legs, leaving 1¼ in. for attaching with half-round clamps. At the front the racks are clamped directly to the back of the front uprights; at the rear the uprights have to be notched slightly in four places. Cover the sides, top and the drawer front with ⅛-in. perforated hardboard to provide ventilation.

SEE ALSO

Closets . . . Drawers . . . Joinery . . . Shoe buffers . . . Storage ideas . . . Storage walls



Antennas for shortwave listening

By FOREST BELT

The secret of good shortwave reception is to match the antenna to the station you want to listen to. If your head is aswim with such terms as "resonance," "frequency," and "wavelength," here's the information you need to choose an antenna that will bring in the stations that you are particularly interested in

THERE'S A LOT to listen to on shortwave: musical programs you can't get on regular radio, ham talk, the drama of police, fire and aircraft calls, and news and propaganda with unusual foreign slants (including our own Voice of America broadcasts). Shortwave radios are available in all price ranges. But none of them can do a good job without a good antenna.

SEE ALSO

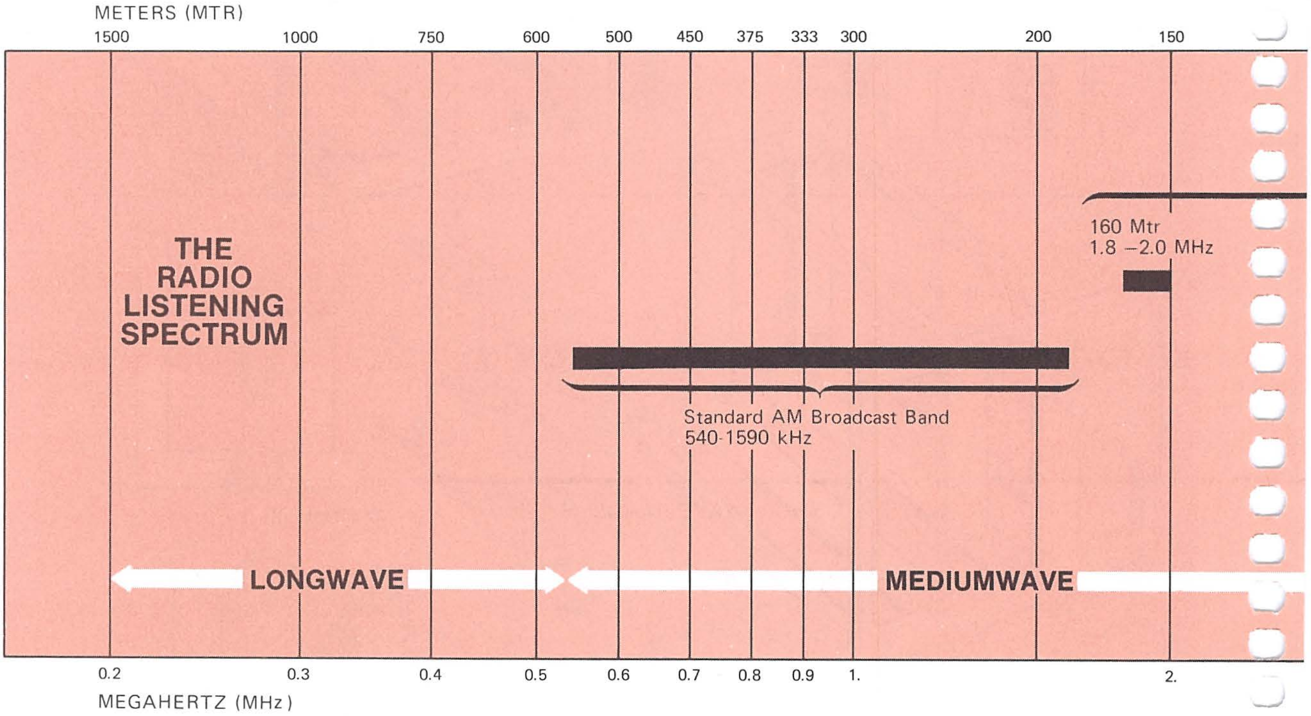
Antennas . . . Electronics . . . Masts . . . Television . . . Transistors

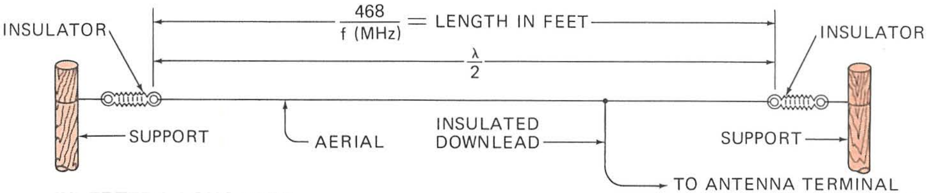
Sometimes that's just a wire hung across the yard (but a precisely cut wire—see next page). Or it might be a fancy-looking gadget on a rooftop mast. Your choice depends on what you want to listen to.

frequency and wavelengths

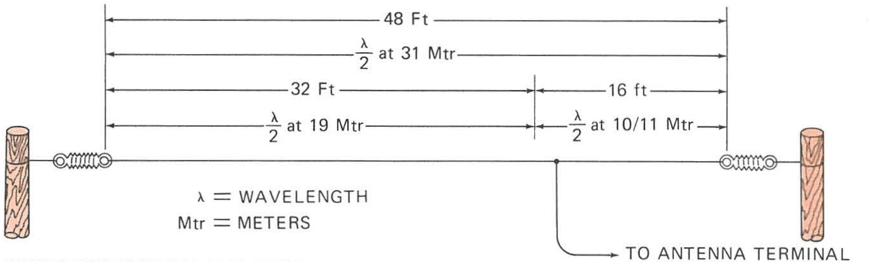
A long piece of wire picks up certain stations well, but a shorter version suits others better. Indeed, a 16-inch wire works best for most police, fire and ambulance broadcasts.

Why? The reason involves *frequency, wavelength* and *resonance*. If you're a shortwave or even a hi-fi fan, you may already know what those terms mean.



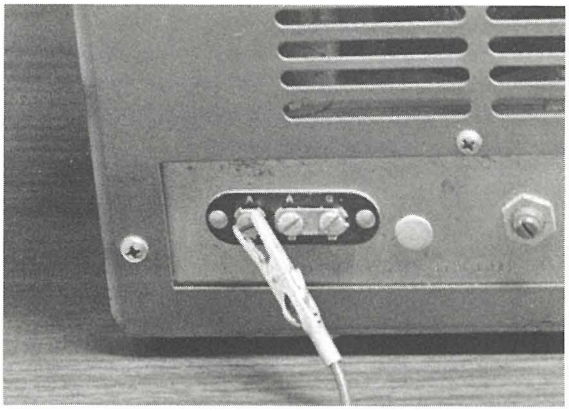

INSULATOR
468 / f (MHz) = LENGTH IN FEET
λ/2
INSULATOR
SUPPORT
AERIAL
INSULATED DOWNLEAD
SUPPORT
TO ANTENNA TERMINAL OF SHORTWAVE RECEIVER

INVERTED L LONG WIRE

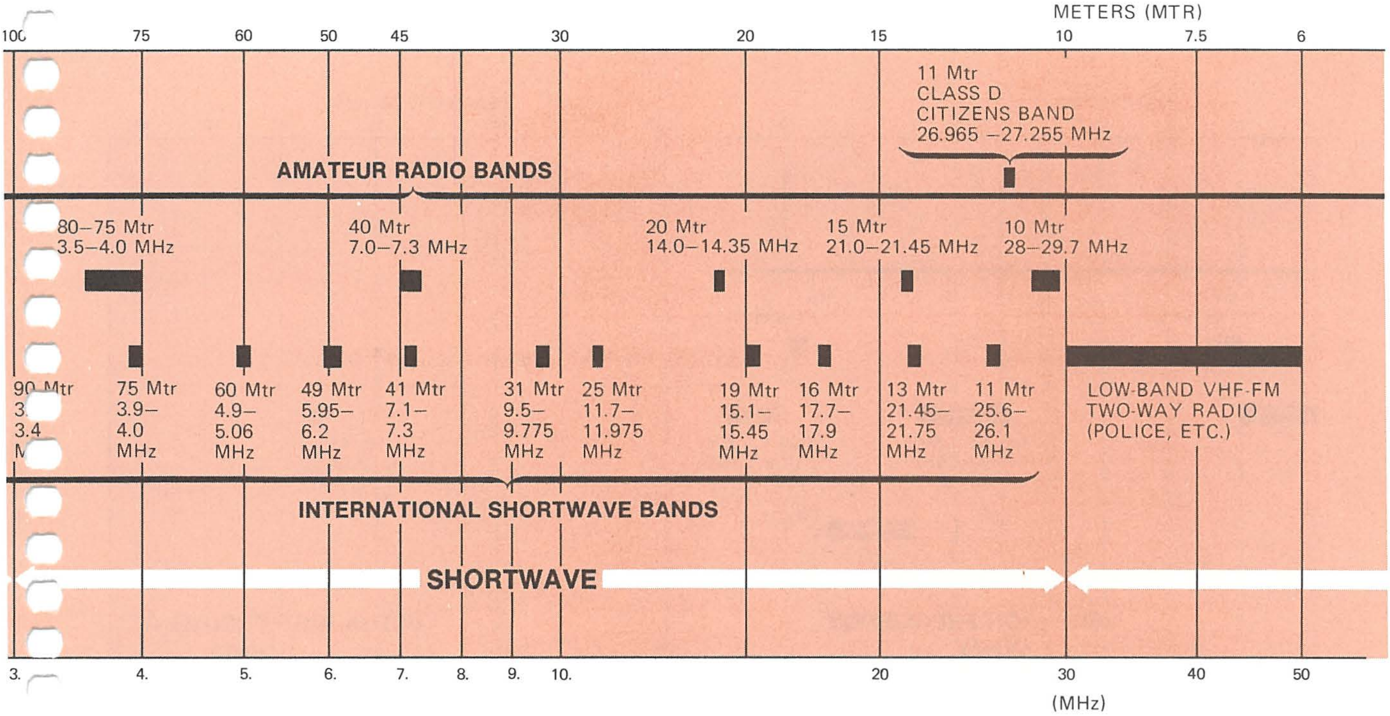


MULTI-RESONANT LONG WIRE

ANTENNA KITS have all materials needed for long-wire antennas.



AN ALLIGATOR CLIP is a good temporary connection for testing reception.



Frequency is marked on the dials of radios. On older sets, they're in kilocycles (KC) or megacycles (MC), which stand respectively for thousands of cycles per second and millions of cycles per second. Many recent radios have the modern equivalents: *kilohertz* (kHz) and *megahertz* (MHz). A megahertz (1 MHz) equals a thousand kilohertz (1000 kHz).

Radio stations everywhere operate on their own assigned frequencies. When you ''tune in'' a station, you're actually setting special circuits inside the radio to *resonate* at the station's frequency. They let you make your receiver sensitive to that one frequency and no other.

Wavelength is just what its name suggests: the length of the radio wave a station transmits, expressed in meters. The higher a station's frequency, the shorter its wavelength. To calculate the wavelength for any station, just divide 300 million (a radio wave's velocity in meters per second) by its frequency in hertz (the number of waves broadcast per second).

For example, if your favorite station operates at 15 MHz (15 million hertz), divide 300 million by 15 million. The answer is 20, so the station's wavelength is 20 meters.

To calculate the wavelength of a broadcast station operating at 750 kHz, divide 300 million by 750,000 (or 0.75 million); this station's wavelength is 400 meters. The chart graphically illustrates the relationship between megahertz (frequency) and meters (wavelength).

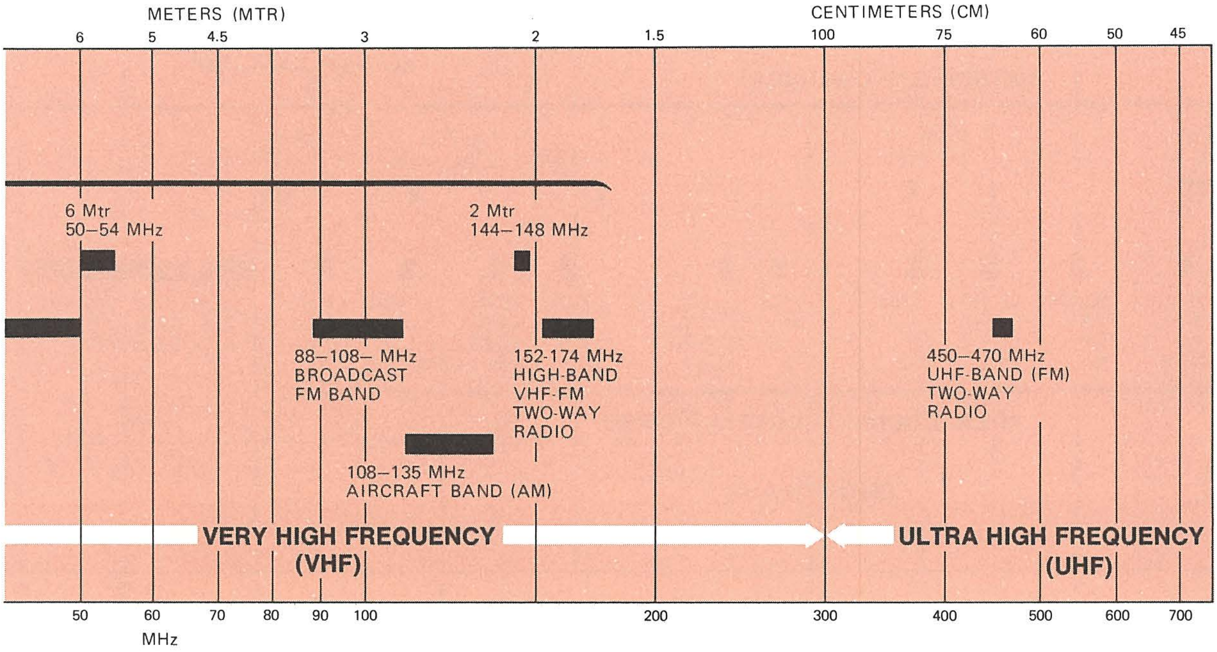
A radio signal is an electromagnetic wave traveling through the air. When a radio signal encounters any metal object, the forces in the wave set up corresponding ''pulsations'' in the metal. The more closely the object's size matches the signal's wavelength, the more strongly these pulsations are induced. The metallic antenna is *resonant*—or tuned—to that radio wave.

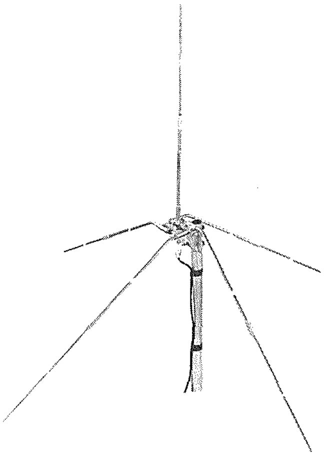
You can cut a metal rod or wire to a length that resonates at whatever frequency you wish; then you feed the induced radio signal down another wire to your receiver. The resonant rod or wire is the *aerial* part of your antenna, and the feed wire is the *downlead*.

Simple shortwave antennas come in two types: *long-wire* and *vertical*. For stations below 25 MHz, the long-wire seems most practical, and easiest to construct. Above 25 MHz, verticals are feasible; but you'll probably buy one ready-made rather than build your own.

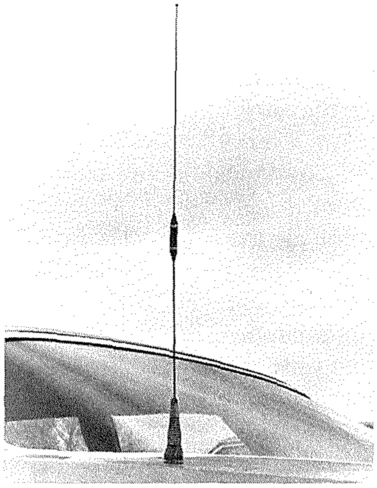
The aerial portion of a long-wire antenna works mainly on a half-wave theory. That is, you make it half as long as the wavelength it should pick up. (The earth beneath the aerial ''reflects'' the other half-wavelength.)

The simple ''inverted-L'' installs easily. You need two insulators, a length of sturdy wire and a downlead wire. The kit shown with the antenna sketch has bare aerial wire, stranded for strength, and a downlead that's insulated so it won't be accidentally shorted or grounded out.

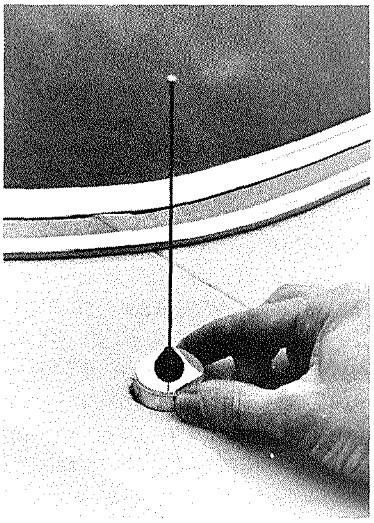




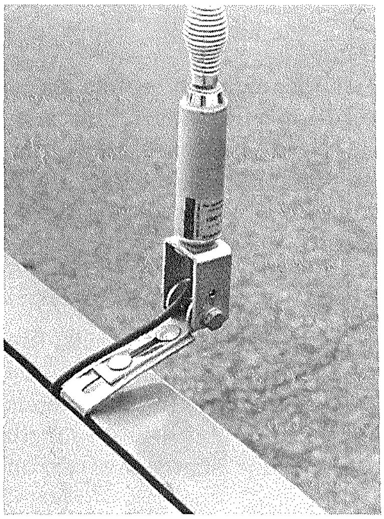
A GROUND-PLANE antenna's rods serve as reflectors.



LOADING COIL in middle of a whip electrically "extends" it.

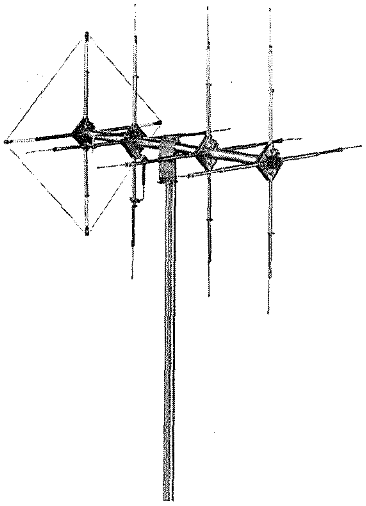


THIS MINIATURE WHIP is a quarter-wave aerial for 2-way FM.



A TRUNK-EDGE CLIP mounts a mobile antenna without drilling.

THE PL-259 PLUG is the commonest for CB and other coaxial leads.



HIGH-GAIN antennas are effective, but can be expensive.

Two standoff knobs support the downlead, and a flat insulated strip passes it under the window sash.

How long should the aerial be? That depends on what you listen to. Suppose you listen a lot to overseas broadcasts from Great Britain on a frequency of 6110 kHz (same as 6.11 MHz). Wavelength of that station (300,000,000 divided by 6,110,000) is 49.1 meters. A half-wavelength is 24.55 meters. Actually, a long-wire antenna should only be 0.95 times as long as this, due to capacitance of its end insulators, so your net length would be 23⅓ meters, or 76.5 feet (a meter equals 39.37 inches, or 3.28 feet). If you want to calculate the wire's length in feet directly, there's an even simpler way: just divide 467.5 by the station frequency in megahertz, and you get the aerial length in feet. (In this example, 467.5 divided by the 6.11 MHz frequency is about 76.5 feet.)

The inverted-L works well both at *and near* its resonant frequency, so the 76-footer is effective for any frequency in the 49-meter shortwave band. But the antenna is sensitive at multiples, too: The wire tunes two half-wavelengths near 12 MHz, the 25-meter shortwave band, and stations near 18 MHz (the 16-meter band) resonate the wire at three half-wavelengths.

Connecting the downlead at a point other than the end may suit a similar purpose. An accompanying sketch shows a wire cut for the 31-meter band, about 9.6 MHz (with a 48-foot, 15.5-meter halfwave). The full length also makes two half-wavelengths for 15 meters. Connecting the downlead 16 feet from the end helps the aerial "divide up." The short section operates on a half-wavelength near 10 (and 11) meters, and the longer one resonates close to 19 meters.

However, exact aerial length is not always necessary. With many shortwave radios tuning frequencies below 25 or 30 MHz, you can use any reasonable length of long-wire antenna, because they include *trimmer* knobs that tune the antenna electronically. Your receiver instruction book tells what lengths of aerial will suffice. If you only have room for a short wire, or perhaps a telescoping rod, you can add a *loading coil* that makes the antenna electrically longer. The coil compresses some antenna length into a smaller space.

quarter-wave verticals

Most shortwave receiving antennas would work better upright instead of horizontal; and above 25 MHz, wavelengths are short enough to allow such vertical antennas—stiff rods or wires called "whips."

A different resonant principle applies here. The vertical aerial operates at one-fourth (a quarter) wavelength. The "other" quarter of the wave reflects on added metal elements called a *ground plane*. (Mother Earth doesn't much affect this kind of antenna.)

Calculating the resonant length of the whip resembles the procedure for long-wire antennas. Take the Citizens Band (CB) for example. Its center falls close to 27.1 MHz, where the wavelength is close to 11 meters. A quarter-wavelength figures out to 2.77 meters, or about 109 inches. In practice, though, various electrical effects make whip antennas a bit shorter—how much shorter depends on both the thickness of the whip (the thicker the shorter) and the material it's made from (fiberglass whips are shorter than aluminum).

The radial rods that form a ground plane for a vertical antenna are about as long as the whip. But sometimes, they aren't necessary: on a car, for example, the body metal, insulated from the whip, simulates a ground reflector.

You've seen plenty of quarter-wave vertical antennas. The whips on police cars, fire trucks and taxicabs are quarter-wave. A whip from 16 to 18 inches long resonates in the high VHF band. Longer whips, from 55 to 90 inches, counting a heavy spring at the bottom, cover the low VHF band from 30 to 50 MHz. Sometimes a loading coil at the bottom or in the center of the whip allows a short whip to cover these frequencies. Several modern two-way radio systems operate in the UHF, above 450 MHz; their whips are only 5 to 6 inches long.

You don't have to deface your car to mount a VHF antenna on it. Though some mobile antennas for shortwave require holes drilled in the car body, there are special mounts that clamp onto the bumper or trunk-edge instead. And a few short vertical whips have magnetic bases, some with stick-on adhesive.

A plain wire downlead doesn't do for quarter-wave verticals. They take *coaxial cable*. "Coax" comprises a wire surrounded by a layer of insulation, then a layer of metallic-braid shield, and covered by an insulated (usually vinyl) coating—similar to hi-fi cables, but thicker.

The cable end at the receiver terminates in some kind of coaxial connector. At the antenna, the center wire attaches to the bottom tip of the aerial whip; the braided shield goes to the ground plane—or to whatever serves as reflector for the quarter-wave vertical.

VHF listening

If your pleasure comes from police calls, fire runs, aircraft landing chatter and the like, you probably use a monitor receiver. If the station is not far away, you may get by with a cut-to-length bit of stiff wire fastened at the antenna screw on the back of the radio.

For more distance, use an outside antenna, which you can buy precut for whatever band you listen to most. Clamp it to a tail pipe mast or a special tower, or use a mounting that fits on the end of the house.

"Gain" antennas offer more sensitivity than a simple ground plane. Their designs build up a stronger resonance than a plain whip does. Extra-sensitive antennas may have whips tuned at some odd fraction—like ⅝ths of a wavelength. More than one whip may form an "array"—sometimes in X-shapes. And if you're interested in one station only, you can get an antenna that concentrates its gain in one direction.

Your window to shortwave listening opens only as wide as your antenna permits, so make sure the aerial fits the stations you want to hear. And if you need to, you can put up more than one.

BB GUN practice shooting at wooden discs tossed by his dad, Gary Randall, gives young Michel a basic lesson in how to learn to use a shotgun.

▨ THE SKILLS OF SHOOTING can be learned at any age, and shotgunning ace Gary Randall of Orlando, Fla., has been refining the methods that helped him as a boy. Now, with sons of his own who are eager to "shoot like dad," Randall is starting them carefully in the techniques that made him a skeet champion.

Since the days of the Pilgrims, American youngsters have been instructed in the safe and proper handling of sporting firearms. Gary learned from his father, William D. "Bo" Randall.

The elder Randall, a perfectionist, started young Gary by teaching him to shoot instinctively. First came a BB gun and a couple dozen small round wooden discs, about three inches in diameter, cut from a thin panel. Both teacher and

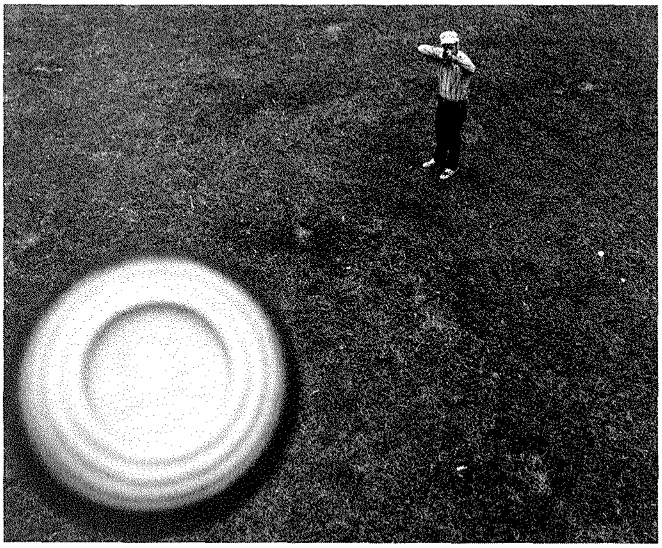
How to start with a shotgun

This grandfather, father and son have worked out a highl successful system combining safety, instinctive skill and fun. They start when the youngster is small using a BB gun and the basics. Before long they graduate to the big guns

By GEORGE X. SAND

SEE ALSO

Ammunition . . . Duck hunting . . . Gun cabinets . . . Gun racks . . . Guns . . . Hunting . . . Marksmanship . . . Muzzleloading . . . Tracking



DEVELOPING AUTOMATIC skills for leading a clay bird the proper amount takes constant practice for "high-over-all" scores. Gary Randall has broken 100 straight.

TAKING AIM at a hand-launched clay bird, Gary Randall shows son Michel how he perfected his moving-target technique which operates instinctively.

pupil wore glasses (for eye protection from possible ricocheting pellets). Standing out of the line of fire about 10 feet to one side and slightly in back of Gary, Bo Randall scaled the little targets, spinning broadside in a slow arc, in front of his son. He tossed the discs one at a time so that they sailed by only about eight feet in front of the shooter.

Gary was instructed to hold his head up, keep both eyes open, and to concentrate on the target, *not* the gun. Holding his air rifle ready at his shoulder, Gary did not aim but just pointed instinctively at the moving disc and then fired when the time seemed right—usually at or near the top of the arc. The gun was pointed as though it were merely an extension of the boy's outstretched arms.

After only a few hours of such father-and-son practice, the pleased boy could hit the seemingly impossible little targets with amazing regularity. "I must have shot many thousands of BBs with my Crossman," Gary recalls. "I would walk through the woods plinking at leaves, twigs and trees practicing when I could."

Before Bo Randall's son was allowed to fire live ammunition at moving targets he was given a thorough course in gun handling with strong emphasis on safety. The firearm he would be using was no toy weapon, one to be aimed carelessly at other humans as is sometimes done in movies and on television. Henceforth, Gary would *never* point a gun—loaded or unloaded—toward another person. The safety would *always* be left

EXPENSIVE SHOTGUN is not essential, but Randall now uses a four-barrel model which costs around $5000.

on until just before he was ready to pull the trigger.

Bo Randall explained to his son how a shotgun shell is made, how it is exploded when the trigger is pulled and the gun's firing pin strikes the shell's primer. The shotgun barrel, and the degree of its possible constriction (choke) to control shot patterns at various distances was discussed. Parts of a shotgun—stock, receiver, trigger, barrel and safety button—were also inspected and their operation analyzed. After each lesson, Gary's father asked questions and kept a record of the boy's progress. Not until he knew all the answers and could demonstrate every phase of proper handling was the boy allowed to have a gun of his own.

That first gun was a 20-gauge pump shotgun with a shortened stock: "I was eight at the time," Gary recalls, "and we had a summer home on a lake in Michigan. Each fall my parents would put me in school up there temporarily so we could stay through October and Dad could hunt grouse. He was a very good shot and wanted me to be one, too, so every weekend we would find a field or some open woods and he would teach me how to hit a moving target."

clay bird practice

"Father would walk close behind me. He carried a handtrap loaded with a single clay bird. When I least expected it, he would send that clay pigeon sailing outward—sometimes high, sometimes low—and then tell me which direction to look." Gary began to learn the concentration, control and confidence needed.

Today the boy who began with an air rifle has graduated to a $5000 Krieghoff shotgun with interchangeable 12, 20, 28, and 410-gauge barrels. (The 16 gauge is not shot in skeet competition; its size is too close to that of the 20.) For three years, Gary Randall defeated all Florida competitors to become "High Over All" skeet marksman in his state. His HOA score was 391 out of 400. (One hundred clay targets are shot in each of the four gauge categories.) Competing only in skeet but not trap, Gary Randall shoots 30,000 flying clay targets a year, about 8000 of these in competition. Like many tournament shooters, he reloads his own shells for economy. Number 9 loads are normally used for skeet shooting.

But Florida's expert is quick to point out that a costly gun is not necessary to becoming a good shot. His choice for a beginning skeet or trap shooter is the Remington Model 1100 autoloader in 20 or 28-gauge size. Popular for light recoil, it is available for right and left-hand shooters and has interchangeable barrels in all four gauges. Winchester, Ithaca and Browning are among other favored makes.

"If a person, young or old, has been taught to properly handle a shotgun and will shoot two or three times a week for one month, he should be able to break 20 or more birds out of every 25 thrown for him," says Randall.

Gary's older son, Michel, is learning from his father the fundamentals of shooting. Concentration is the key to success in skeet, says Gary. Each station presents its own unique problems as its released target flies at a new angle. The required lead—the distance one must aim ahead of the moving target—varies. So does the speed and timing needed to track the target, move ahead of it, then follow through with the swing after firing. Randall advises beginners to face the center stake squarely. Stand comfortably with feet at shoulder width, one foot a little ahead of the other. Lean forward slightly, until about 60 percent of your weight is on the forward foot. Keep your head up with both eyes open, looking at the spot where you judge the clay bird will be emerging. Bring up your gun with a single smooth movement so that the butt rests firmly against your shoulder and the comb of the stock lightly touches your cheek.

watch the target

Do not sight down the barrel as you would a rifle. Rather, keep your eye on the target so you can view the bird and gunsight at the same time. Never hunch your head down, but form an even sight line along the barrel or rib. Bring your gun up to your eye, not your eye down to the gun. When you swing to shoot, move your whole body, not just from the waist up.

"It will help a beginner to understand lead better if he can picture the shot coming from his gun as though it were a strong stream of water being squirted from a hose. In order to hit an object passing quickly before him, he would have to catch up with the target, then keep the hose stream just in front of the object," Randall advises. Two of the most common mistakes, Gary notes, are raising the head during shooting and stopping the swing of the gun as the trigger is pulled. Allowing the gun barrel to cant in a tilt to one side also causes misses.

Randall does not recommend that shooting be done in one's back yard. Instead, he urges beginners to join an organized gun club.

How to select a modern shotgun

By GARY GILLESPIE

Whether it be for skeet, trap or game, you are faced with a large assortment of guns from which to make a final choice. Here are the basics you should know before you choose a shotgun which is suited to your activities

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SEE ALSO

Ammunition . . . Duck hunting . . . Gun cabinets . . . Gun racks . . . Guns . . . Hunting . . . Marksmanship . . . Muzzleloading . . . Tracking

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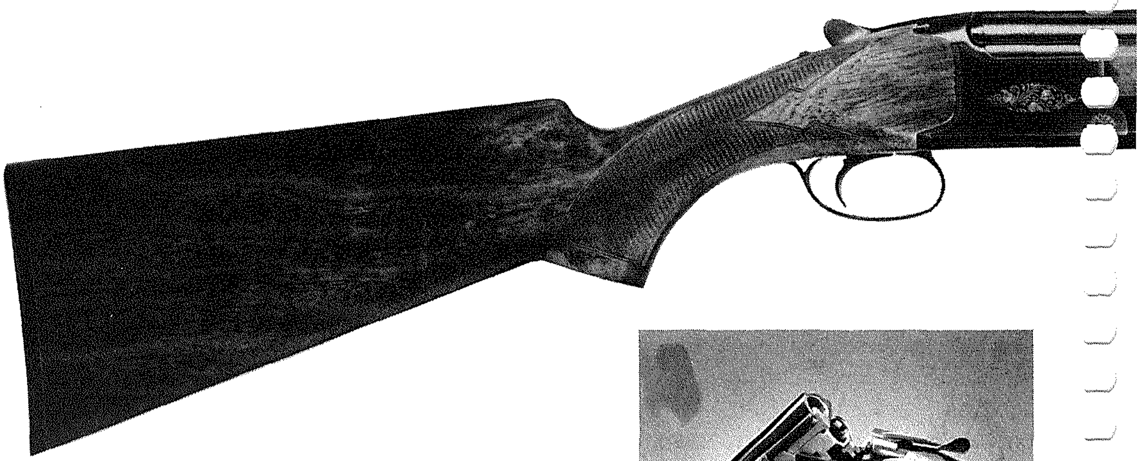
■ IN A COUNTRY once described as a "nation of riflemen," the shotgun has become America's most widely used and versatile hunting and target tool. True, the rifle remains king for certain types of long-range accuracy, particularly for big game. But in all-around use, the scattergun now ranks first across fields and forests, trap and skeet ranges. As proof of this popularity, there now exists a wide variety of shotgun models, actions, gauges and prices.

To anyone in the market for the latest in smoothbores, this presents a problem and an opportunity. It is difficult to choose from so many options, but there is also a better chance to find a shotgun particularly suited to your activities.

☐ *Single shot* is usually the lowest priced action, except for expensive trapshooting models. With simple "break-open" design, it is a popular beginner's gun, particularly in "youth" versions with short stocks. Due to its limiting one-shot feature, however, it is a poor long-term choice for serious hunting.

☐ *Pump action* is a feature of America's basic "bread and butter" shotgun. Its rugged dependable action requires little maintenance. For



OVER AND UNDERS, like new Browning Liege (above and at top), permit barrels with different chokes on the same gun.

UPLAND GUNNERS prefer a light, fast-handling model, often 20 gauge, for short-range work such as this hunter shooting for quail in the Southwest.

varied types of shooting, look for models permitting interchangeable barrels with different chokes. These can give you, in effect, three shotguns for about 50 percent more than the cost of just one.

☐ *Semiautomatic* is usually called "automatic" or "autoloader." This gun reloads automatically each time you pull the trigger and fire. Automatics are more expensive than pump actions and require more frequent cleaning and maintenance. They are appropriate for all types of hunting and highly versatile when the barrels are interchangeable. They excel for the fast shooting encountered in skeet doubles and such sports as quail and dove hunting. Gas-operated models are lighter in recoil—a worthwhile factor for both youngsters and ladies.

☐ *Bolt-action shotguns* are repeating models that use the familiar rifle-type action. Usually they lack the "feel" and swinging qualities of more common shotgun actions for serious hunting, but can be good, low-priced utility guns for occasional use on garden pests and the like.

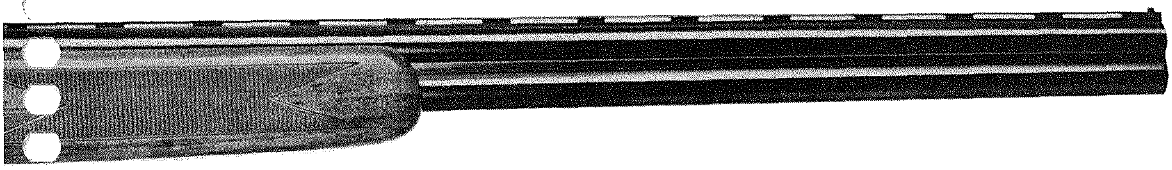
☐ *Over-and-under double barrel* models have been growing in popularity recently but generally are the highest priced type of action. Two barrels, positioned one atop the other, permit two chokes on the same gun—open for the first shot and tighter for the second. The over and under is ideal for hunting upland birds such as grouse and pheasant.

☐ *Side-by-side double barrel* has the two barrels positioned horizontally. Advantages are similar to those of over and unders, but these are often lighter and faster handling. For budget buys, look for two-trigger models without automatic ejectors.

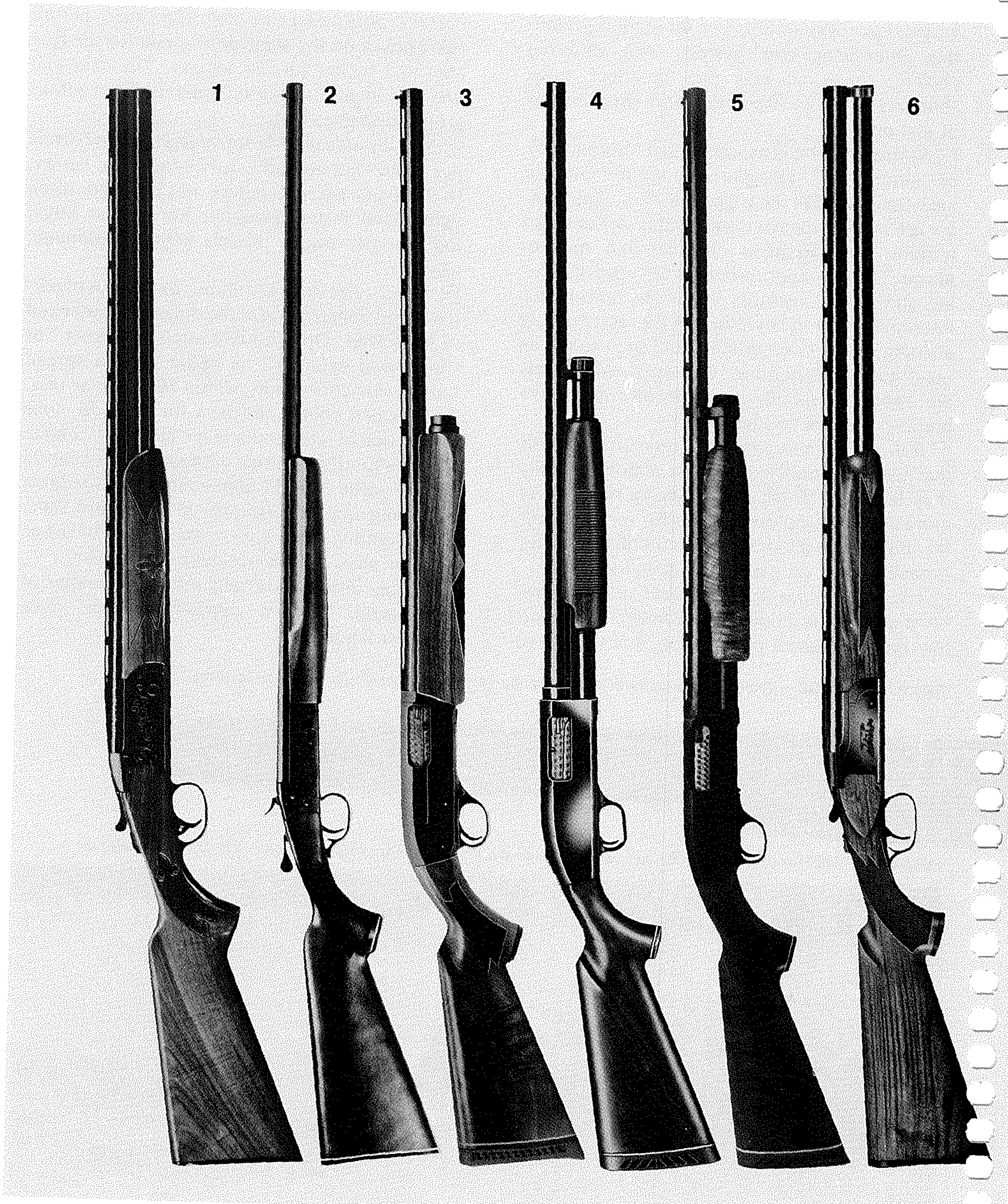
☐ *Choke selection* determines the degree of narrowing or constriction at the muzzle or outer end of the barrel. Open chokes such as "skeet" or "improved cylinder" let pellet pattern spread quickly for close shots within 30 yards or less. These open chokes are best for game in close cover. Select intermediate or "modified" choke if your shooting is varied with ranges between 25 and 40 yards. "Full" chokes throw the tightest long-range patterns best for 35 to 50-yard shots when hunting large wary game such as wild turkeys or pass shooting at ducks and geese.

☐ *Gauge designation* tells relative diameter of the barrel. Largest capacity gauges have smallest numbers.

BROWNING LIEGE, with newly popular over-and-under barrels is example of high-quality economy.

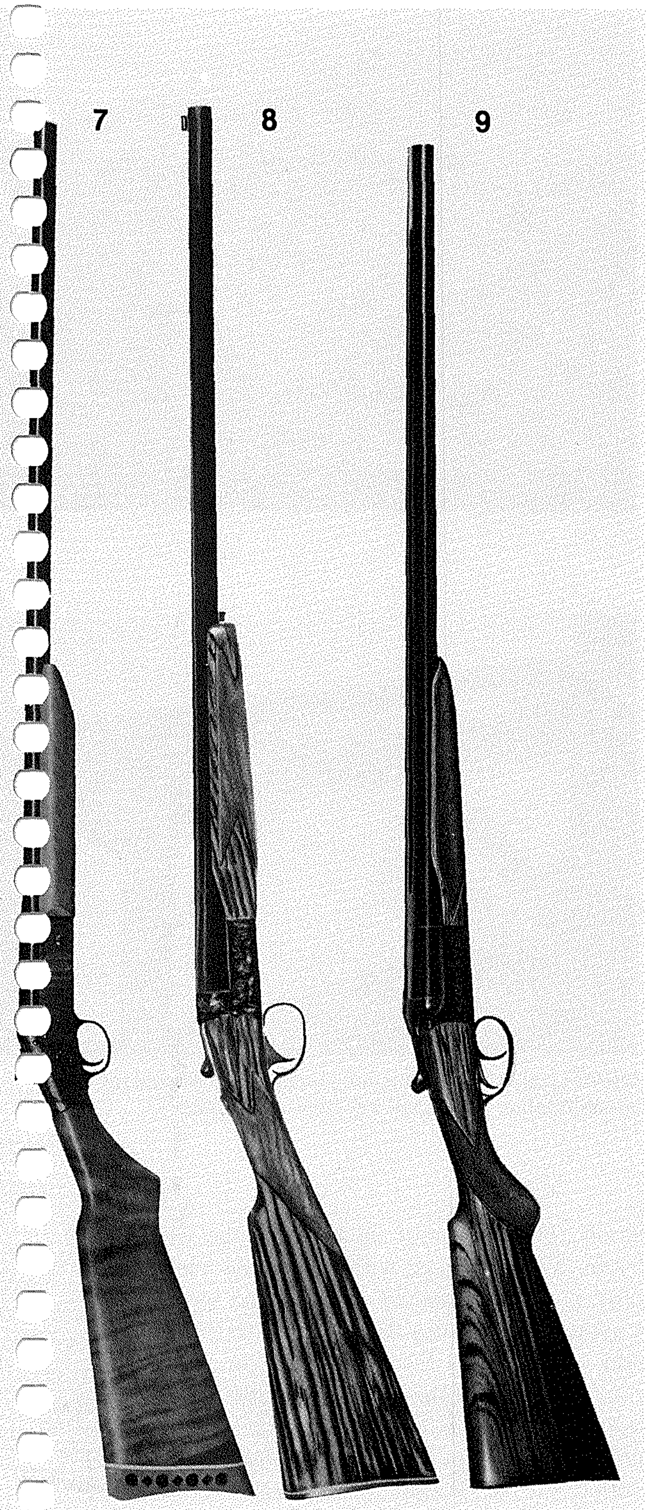


FULLY-EQUIPPED waterfowl hunter can use 20-gauge over decoys; should pass shoot with 12 or 20 magnum.



1. SAVAGE 333, new over and under in 12 or 20 gauge, has ventilated rib, auto ejector and interchangeable barrels. 2. Winchester new single-shot, Model 37A, comes in 12, 16, 20, 28, 410 gauges; has shorter stock for 410, 20. 3. High Standard Supermatic gas-operated autoloaders have 26, 27, 28 or 30-inch barrels. It comes in either 12 or 20 gauge.

4. MOSSBERG MODEL 500 pump comes in 12, 16, 20 gauges. Pederson Custom Guns will feature fitting, import actions. 5. Marlin 120 Magnum 12-gauge pump has 3-inch or standard shells. The trap 120 has a Monte Carlo stock and a 30-inch barrel. 6. Remington's 3200 is a modernized version of the famous Model 32. O/U 12-gauge field, trap and skeet models are available.



7. HARRINGTON & RICHARDS Model 158 is a single-shot gun that is available in 12, 16, 20 and 410 gauges. 8. Ithaca Gun's new double-barrel Model 280 side-by-side in 12 and 20-gauge has traditional English-style stock. 9. Beretta GR-2 from Garcia is a classic side-by-side double which is available in either 12 or magnum 20-gauge with double triggers.

SEARS EXTENSIVE gun line, all tested by Ted Williams, includes this low-recoil auto. Here Williams is holding the O/U Magnum 12.

10-gauge: Uncommon today. Found only in a few double-barrel shotguns.

12-gauge: The most popular gauge. Appropriate for all target shooting and hunting; best choice for the one-shotgun man who hunts a variety of game.

16-gauge: Declining in use, superseded by heavier loads in some 20-gauge shells.

20-gauge: Good choice for upland game where faster, lighter handling helps. Adequate for ducks over decoys; not for pass shooting. Lighter recoil aids beginners, ladies.

28-gauge: Fast handling with no noticeable recoil, but light shot charge restricts it to experienced gunners hunting small upland birds at short range.

410-gauge: Light shot charge is more likely to cripple than down game. Best reserved for target use or pests of barn-pigeon category. Don't choose 410 for beginners; it's a difficult tool, for experts only.

☐ *Magnum* shotguns in 12 and 20 gauges will take larger shells that open to 3 inches after firing, rather than the standard length of 2¾ inches. Heavier shot charges give greater range.

☐ *Rifled slugs* fit any shotgun, are slightly more accurate in skeet or improved cylinders. Slug barrels with rifle sights are available.

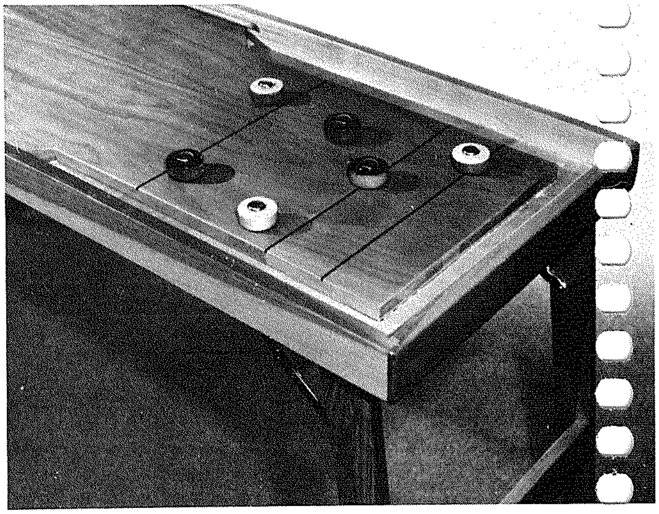
☐ *Selection* should be based on good feel and fit of gun, recommendations of friends, considerable shopping and catalog study. A good dealer can order specific models. Young beginners might start with a 20-gauge pump with shortened stock. For waterfowling, pick 12 or 12 magnum pump or autoloader. Same gun with interchangeable barrels or adjustable choke, or 20-gauge magnum, is a good all-around choice. For short-range upland game, a 20-gauge is suitable, while long range requires 12-gauge or 20-gauge magnum.

And the best buy? An American 12-gauge pump action with interchangeable barrels or adjustable choke probably offers the most for the money.

Build a shuffleboard table

By CARROLL G. HAKENSON

Table shuffleboard can be a fun game for up to four people. When you make the table yourself, complete with inlaid scoring zones and weighted pucks, it adds to your enjoyment

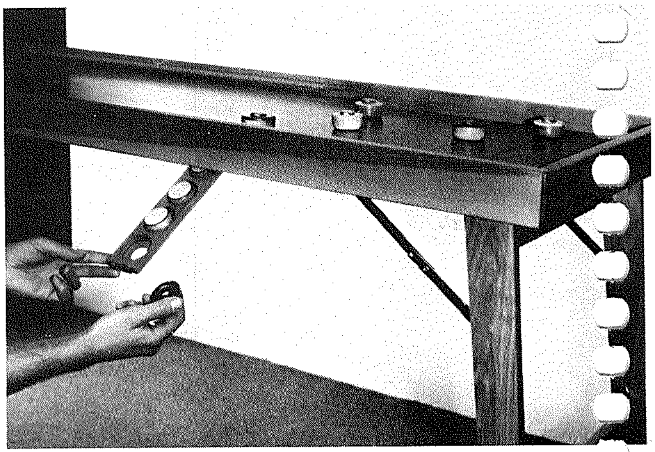


HERE'S A GIFT the whole family can enjoy—a table shuffleboard. The waxed bed is of solid-core birch plywood with the scoring zones inlaid with strips of ⅛ x ⅛-in. walnut. The grooves for the inlays are saw kerfs made on the bench saw.

The 1x3 birch rails have interlocking joints at the corners. To make such joints, you first groove the end rails to the depth shown. Then you cut the ⅛-in. slot and tab with one cut at right angles to the groove. To make the side rails, after cutting a ⅛-in. notch in the end of the rail as shown, you turn the rail over and make a second cut to create a ⅛-in. tab. Finally, a ⅛-in. slot is made to the depth shown. To make the rubber bumpers, insert ⅛" dowels in surgical tubing and cement to the side rails.

The 12 weighted pucks are mass-produced from ⅝-in.-thick wood in the following manner. First the wood is clamped to the drill-press table and a ¾-in. hole is bored completely through the wood. Then, without unclamping the work, the ¾-in. bit is replaced with a hole saw and a 2-in. plug is cut completely through the wood. Next a same-size Formica disc is cut with the hole saw and cemented to the bottom of the puck. Now the outer edge of the puck is smoothed by holding it lightly against a disc sander, after which the top and bottom edges are chamfered slightly by hand with a flat file. Finally, each puck is weighted by filling the center hole with molten lead and capping with a metal chair glide. Each set of three pucks is color-coded by painting the tops.

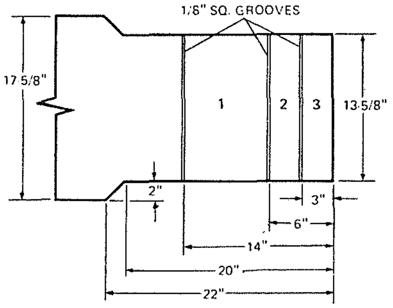
To make the storage wells, bore 2-in. holes completely through the ¾-in. thickness. Then ⅛-in. tempered hardboard is glued to the underside and 1-in. finger holes are bored in the center of the 2-in. holes.



SHUFFLEBOARD weights are stored in the hinged rack beneath table. Each rack will hold six weights.

SEE ALSO

Air games . . . Chess sets . . . Cribbage boards . . . Family rooms . . . Game tables . . . Games . . . Gifts, Christmas . . . Pool tables . . . Puzzles . . . Weekend projects

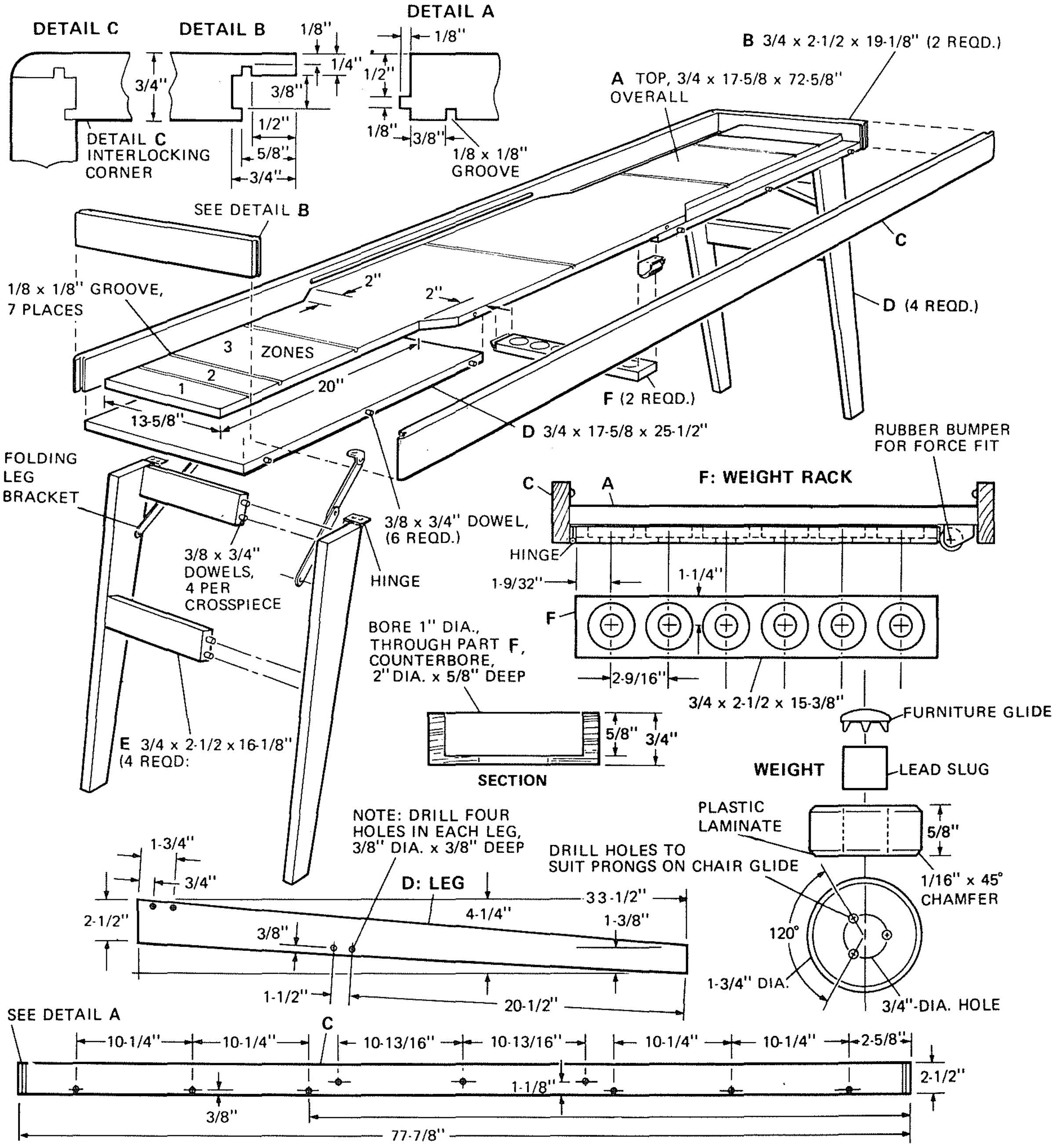


Rules for Shuffleboard

Number of players: Two, three or four.

Object of game is to slide weight down the table, with one rebound off side bumper, and have it land in one of three zones. Nearest zone counts one point, middle zone two points, end zone three points, overhanging weight four points. Score goes to player who has weights ahead of his opponent's. Only weights ahead of the opponent's weights are counted when you're scoring.

Each player has three weights per turn; first player to score 21 wins. Players alternate shots, scorer shoots first on next round.



Choose the right siding

There's a wide variety of smart materials available to give your home new sparkle. Make your selection from those shown here, and others you'll find at your lumber yard

By RICHARD NUNN

THE EASE OF installing the new vinyl siding is dramatically illustrated in this photo as it goes over a well-weathered clapboard siding. Furring strips are needed along with window casing sealers.

▨ THE RANGE of siding materials available to you is so broad you can dress up your home almost any way you wish. For example, in aluminum siding alone there are 15 colors, 7 textures and 12 designs that produce at least 1260 variations. Added to this are designs and textures in plywood, hardboard, vinyl, asbestos-cement, redwood, cedar shakes and shingles, regular wood and fiberglass siding.

Vinyl siding is the newest on the market, and vinyl also is being used to coat wood and metal sidings to increase their durability and decrease maintenance. Vinyl siding is manufactured from a plastic called polyvinyl chloride (PVC). The big features are an end to maintenance and painting. The colors go completely through the material, and only an occasional washing with a mild detergent and water keeps it looking new. Also, it won't dent, scar, corrode, stain or scratch.

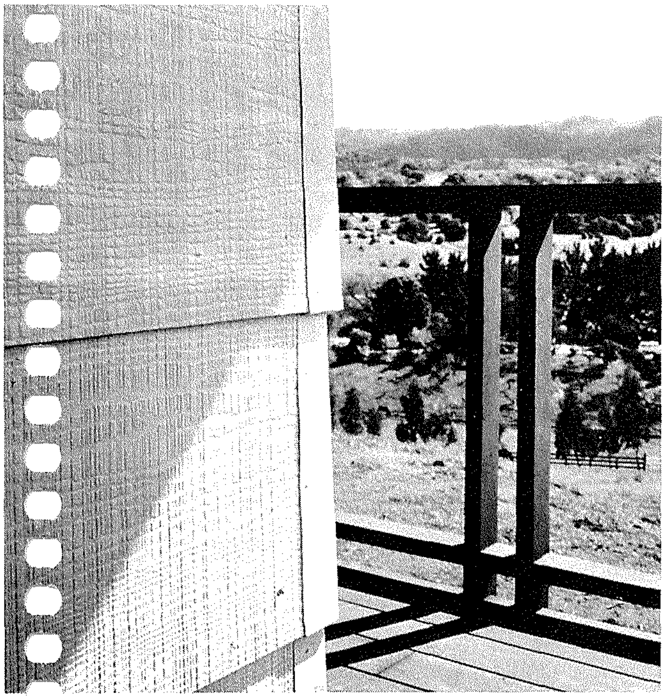
The material is manufactured in regular double 4 and 6-in. clapboard designs and single 6 and 8-in. sizes. A vertical 8-in. board is also available; it resembles regular tongue-and-groove siding after it has been applied to the house. Installation of the material is nearly identical to putting on aluminum siding. However, a 3/16-in. gap should be left at the end of each "board" that butts against a stop—such as a corner or window—so the material can expand. The panel should also *hang* on the nails. The nails should never be driven in too tightly since the material will expand. This is also true of aluminum. No special tools are required to install vinyl siding.

Wood siding is probably the most common and one of the most attractive siding materials available. Most wood siding has a pattern "built in," through a distinctive cutting method. The common types are drop (or rabbeted) and bevel. Rabbeted drop siding has a groove cut along one edge. The lap of each board over the next lower one is determined by the depth of the rabbet. This material is usually ¾ in. thick and 6 in. wide.

Rabbeted siding, like bevel siding, should always be applied over sheathing. On walls which are too long for coverage by one board, the butt joints between boards should be made at random, so all joints don't appear in a straight line. Galvanized or aluminum nails should be used; the nails should be driven flush with the

SEE ALSO

Hardboard . . . House additions . . . Ladders . . . Lumber . . . Nails . . . Remodeling, exterior . . . Scaffolding . . . Sheathing



NEW HARDBOARD siding has the ruggedness of rough-sawn, deep surfaced lap siding. The metal corners are prefinished to match it.

END WALLS of this lakeside home utilize Texture One-Eleven plywood siding on both sides of prefab panels framed with 2 x 2-in. lumber.

surface. At all corners, the ends of the boards must be butted against a corner board or mitered for a pleasing appearance. Water tends to creep into mitered joints more easily than into tightly butted ones. Metal corners are available; they are preformed to fit over the siding and are fastened on with nails.

Bevel siding has one edge thicker than the other. The board in cross section looks like a wedge. The thin edge is usually 3/16 in. thick; the thick edge varies from ½ in. to ¾ in. The boards are available in 4, 6, 8, 10 and 12-in. widths. In estimating your job, remember that the boards overlap each other, so no board will cover its maximum width.

Lay out your siding job so the bottom of one board will occur at the bottom of the window sill and the bottom of another board will run right over the top of the window frame. This produces a much neater appearance and eliminates cutting.

Horizontal and vertical aluminum siding, which is prefinished in a variety of colors, textures and designs, forms a sidewall that will probably outlast the framework of the building. It is manufactured in Double-Four (two 4-in. panels on one 8-in. siding piece); Double-Five (two 5-in. exposures on one 10-in. siding piece); Dutch-Lap with special contours that produce a Dutch Colonial effect; vertical that is 8 in. flat with no bends or contours, except for interlocking grooves; vertical 10-in. board and batten or V-groove effect; and vertical 12-in. board and batten or V-groove effect. Textures include rough, horizontal wood grains, vertical wood grains, stucco effects, embossed and basketweave effects. The lengths of the "boards" run from 10 to 15 ft.

Plywood siding has many features including beauty, strength, high insulation values, economy and durability. It comes in many grades and surface textures including reverse board and batten (with deep, wide grooves cut into brushed, rough-sawn, coarse-sanded or natural textured surfaces); rough-sawn and kerfed; circular-sawn; brushed; fine-line with fine grooves cut into the surface; striated; medium density overlaid; MDO reverse board and batten, and MDO horizontal lapped.

This material, as thin as 5/16-in., can be applied over plywood and other wall sheathing with studs on either 16 or 24-in. centers. "Sturdi-i-wall" construction, where the plywood is applied directly to the studs, is accepted by the Federal Housing Administration and most local building codes. The technique can save as much as 20 percent over a conventional two-layer wall.

Hardboard siding is manufactured in lap siding and panels. The lap variety ranges in size from 6 to 12 in. and up to 16 ft. in length. It may be applied over sheathed or unsheathed walls with stud spacing not more than 16 in. on center. If you use a hardboard siding with a factory-applied primer, it must be painted within 60 days after installation. You can, however, reprime it with a quality exterior-grade oil-base primer.

Hardboard panel siding comes in 4 in. widths up to 16 ft. in length. The same general application recommendations for lap siding apply here. For batten strips at the vertical joints you may use either wood or strips of the siding cut to the desired width. Intermediate batten strips may be used for design purposes. Some factory prefinished siding comes with matching plastic or metal snap-on batten strips. The sizes available are 4 x 7 ft., 4 x 8 ft., 4 x 9 ft. and 4 x 10 ft. Thicknesses are ¼, 3⁄16 and ⅛ in. The recommendations above apply only to ¼-in. panels. For panels of other thicknesses, be sure to consult your lumber dealer for recommendations.

Cedar shingles and shakes have been popular as a roofing and siding material for centuries. In the early days of this nation, cedar shakes were split by hand from sections of cedar logs.

For siding, three types are generally used: rebutted-rejoined shingles, machine-grooved shakes and handsplit shakes. Rebutted-rejoined shingles are precision-trimmed for sidewall use, both single-coursed and double-coursed. The edges have been machined to close tolerances, and the butts are trimmed at right angles to the edges. Often these shingles have been face-sanded to provide a smoother surface for finishing. The shingles are sold in cartons, with 56 courses of 18-in. shingles per carton, and 66 courses of 16-in.

Machine-grooved shakes are also called "processed" shakes. They have a striated or grooved face with parallel edges and squared butts. You may apply them double-coursed on exterior walls with an underlay of low-grade shingles or insulation-board sheathing. Two sizes are available—16 and 18 in.—with a weather exposure of 12 and 14 in. They are packed in a carton that provides 100 sq. ft. of covering to these exposures.

Handsplit shakes come in three different types: handsplit and resawn, tapersplit and straightsplit. Generally, the length for all three is 24 in.; however, 18 and 32 in. are sometimes referred to as "standard" sizes. You can buy them in 4-bundle, 5-bundle and 6-bundle squares, depending whether they are packaged in 20-in. or 18-in. "frames." If your home is already shingled and you want to replace a section or one shingle, you often can buy all three in "broken" lots.

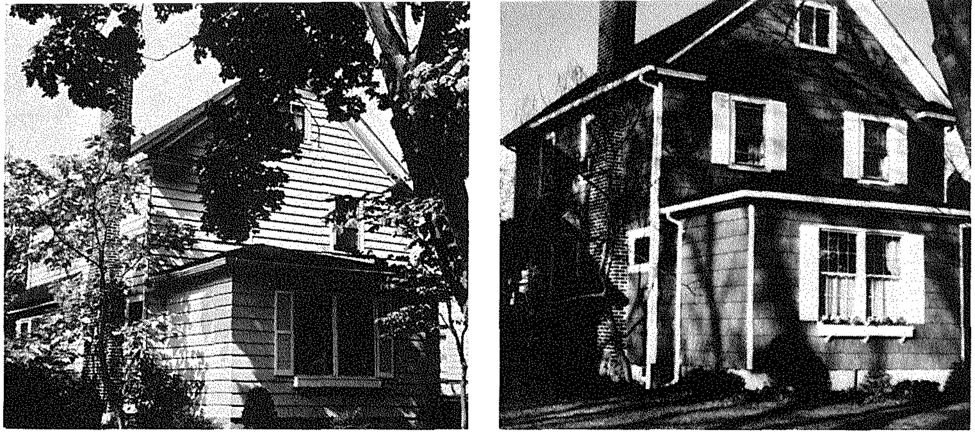
When buying this material, keep in mind that it's sold by the "square"—a roofing term meaning that a square will cover 100 sq. ft. of roof, not sidewall. Since the sidewall exposure will usually be greater than a roof, a square will cover more than 100 sq. ft.

Asbestos-cement siding and shingles are durable, attractive and can be applied over any sidewall surface. Because of their physical properties, they lend themselves to areas where the atmosphere is loaded with chemical fumes and smoke. The size most frequently used measures 5⁄32 in. thick by 12 in. wide by 24 in. long. The shingles are applied with a 1½-in. lap, require no undercourse, and have an exposure of 10½-in. An asbestos-cement 4 x 8-ft. panel is also available, along with clapboard or wide siding board. In design, they are made in a straight vertical pattern—similar to striated plywood—in a woodgrain pattern and smooth. Colors are available and they're impregnated throughout the product.

Fiberglass stone and brick is another recent development in the siding field. The material comes in sheet form—usually 2 x 4-ft. pieces—and it can be nailed directly to sheathing or furring strips on existing homes. It's basically made from fiberglass—plus additives—so it is resistant to the weather, chemicals, etc. Only an occasional hosing down with water is required to keep it looking like new. On one brand, Roxite, the edges are lapped and nailed. After the panels are up, a special caulking compound is provided so the joints can be "tuckpointed." This operation is done with a regular caulking gun. The "mortar" is then smoothed with a tapered piece of scrap wood. A similar item in the same line is "premortared" so the caulking operation isn't necessary. Other siding includes simulated brick and field stone. It, too, is easy to install over sheathing or existing siding with furring strips and nails.

Corrugated metal siding—steel and aluminum—is manufactured in two styles: 1¼-in. pitch and 2½-in. pitch. Both have a mill finish or a stucco-embossed finish. All styles, widths and thicknesses are available in lengths of 6, 7, 8, 9, 10, 11 and 12 ft.

Fiberglass panels are available in sheet form—both flat and corrugated—for siding jobs such as patio enclosures and windscreens. Many colors are available.


THESE BEFORE-AND-AFTER photos were taken during the first and last weeks of the same month. The old siding (left photo) was cracked and peeling and often needed paint.

By HARRY WICKS

Re-siding: you can do it yourself

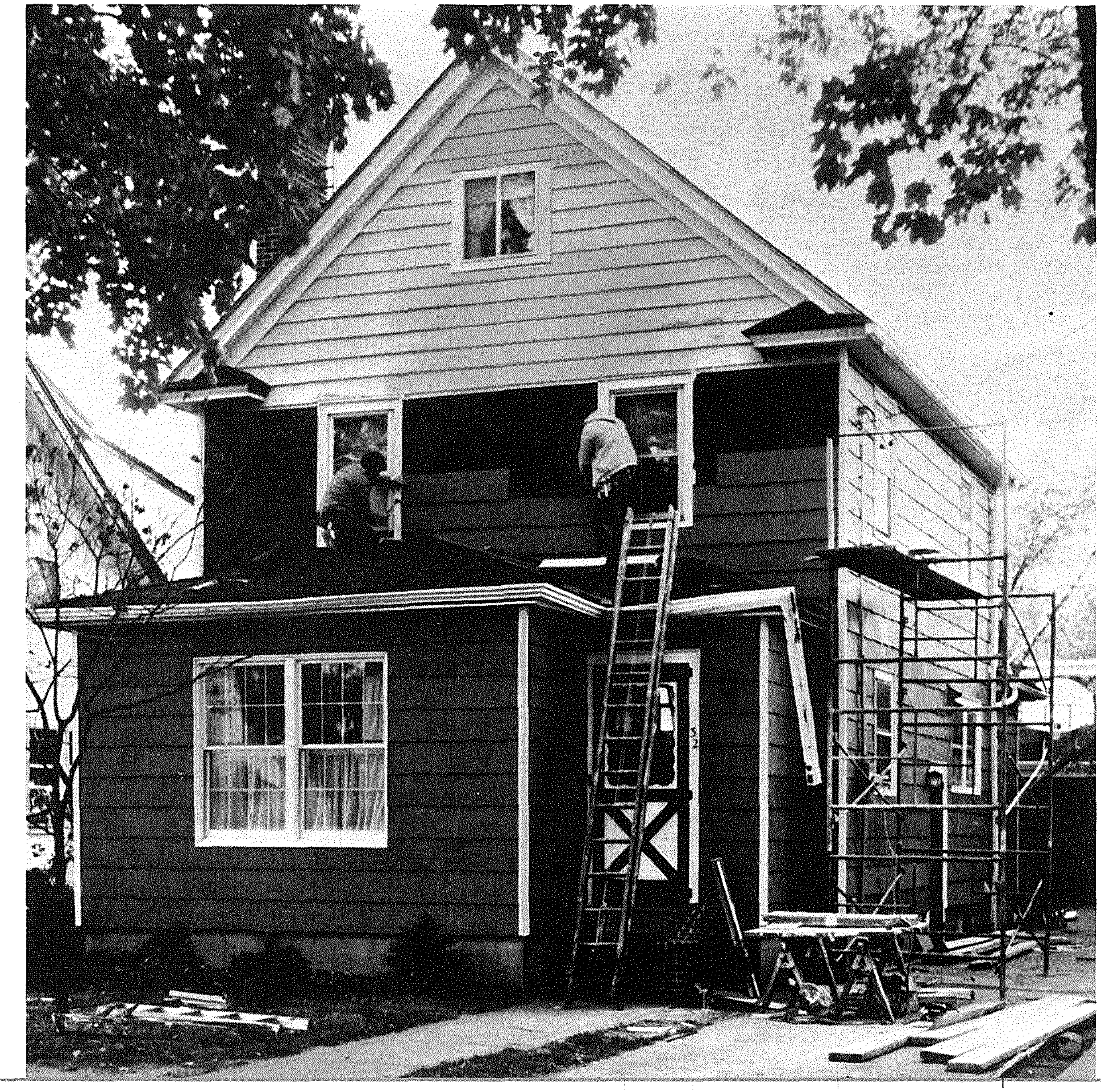
SEE ALSO

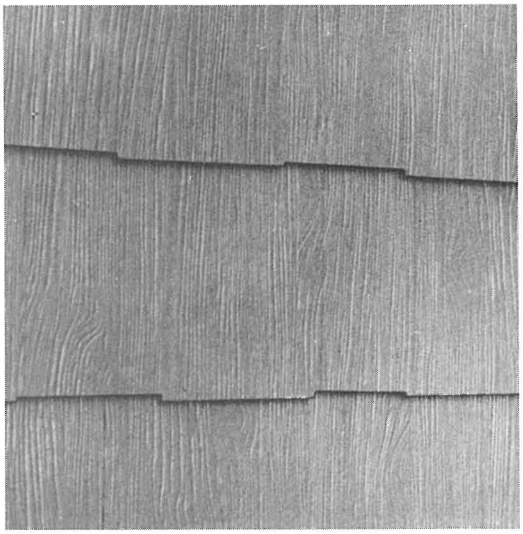
House additions . . . Ladders . . . Lumber . . . Remodeling, exterior . . . Scaffolding . . . Sheathing

LIKE MANY HOMEOWNERS, I simply grew tired of repainting my house every few years. That, plus the fact that I had the unrewarding experience of having paint blister, peel and scale

text continues on page 2781

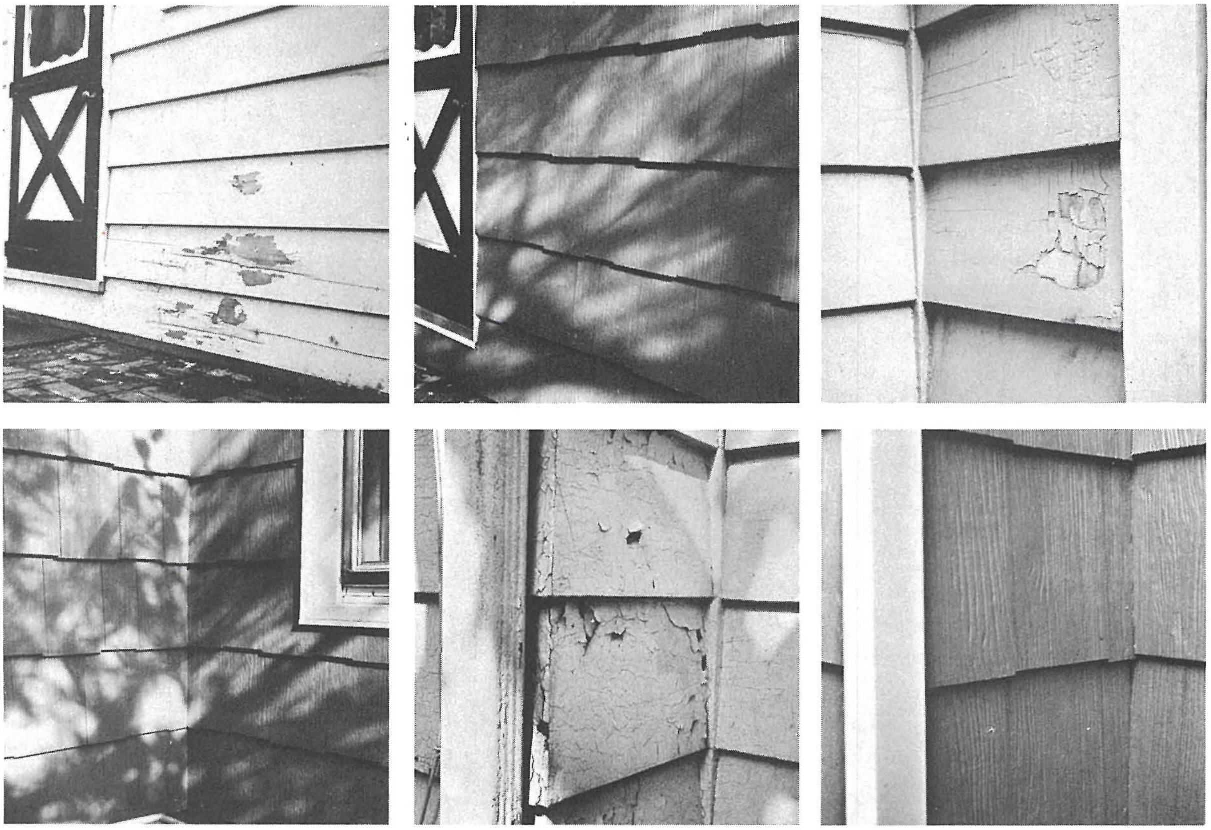
WITH ONE SIDE completed, the author and a friend work their way up the front of the house.





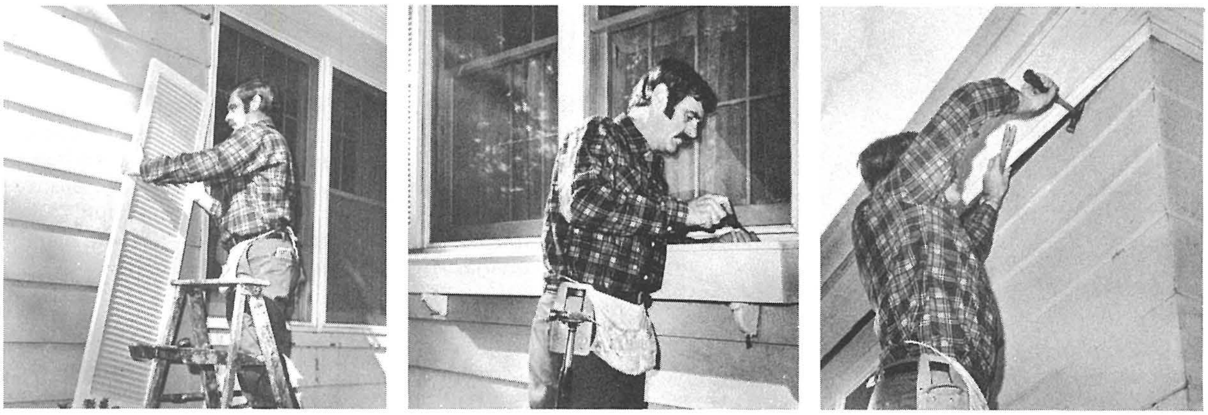
MINERAL SIDING can be worked easily with tools most do-it-yourself enthusiasts have at hand. Shingles come in 4-ft. lengths in your choice of nine colors. Scaffolding makes the job far easier and is well worth rental fee. Without it, some siding jobs would become virtually impossible. A close-up view of the totally prefinished siding (left) shows its attractive wood-grain surface and texture.

Why the job was necessary



A STUDY OF the old clapboard siding makes clear why still another paint job held so little appeal. The same sections of the house, shown with the old siding and the new mineral shingles, show how great a difference can be made by new siding. At the time of these photos, the last paint job was only two years old. It had included a thorough scraping, spot priming with aluminum paint, an alkyd prime coat, topped with an alkyd finish coat. Bays between the studs had been vented. But still the paint cracked and blistered. We used quality paint throughout—but it failed. The decision for new siding wasn't difficult to make.

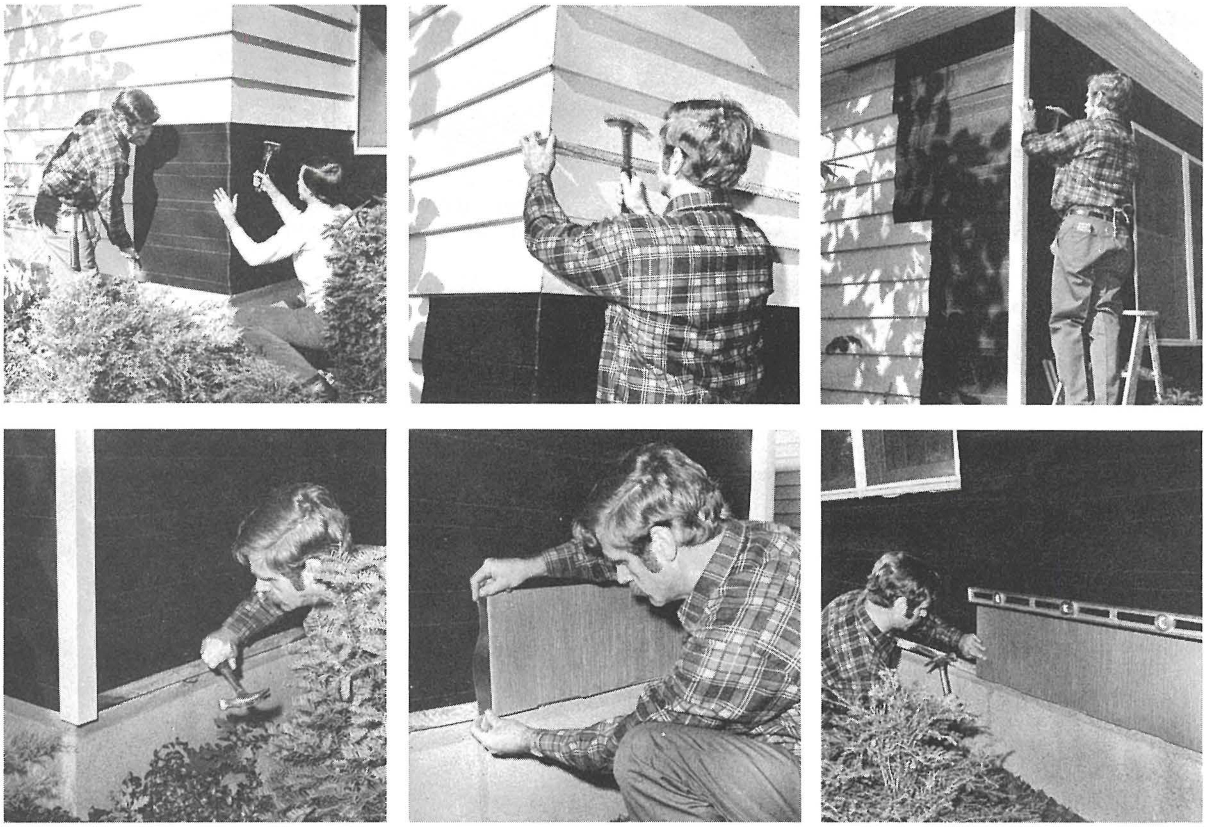
Getting ready for the siding



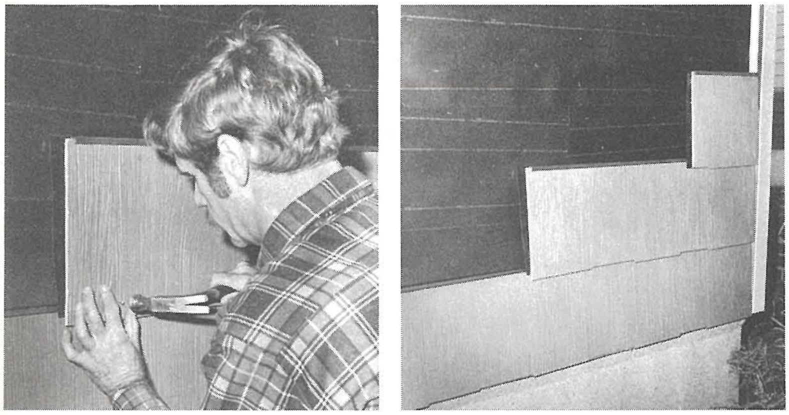
THE FIRST STEP is to remove all attachments such as shutters (left) and the flower box beneath windows (center). Molding at the soffit-wall joint also comes off. In this instance, workmen replaced that strip of molding with a double layer of wood lath so as to avoid changing the original profile.

re-siding your house, continued

Applying the siding

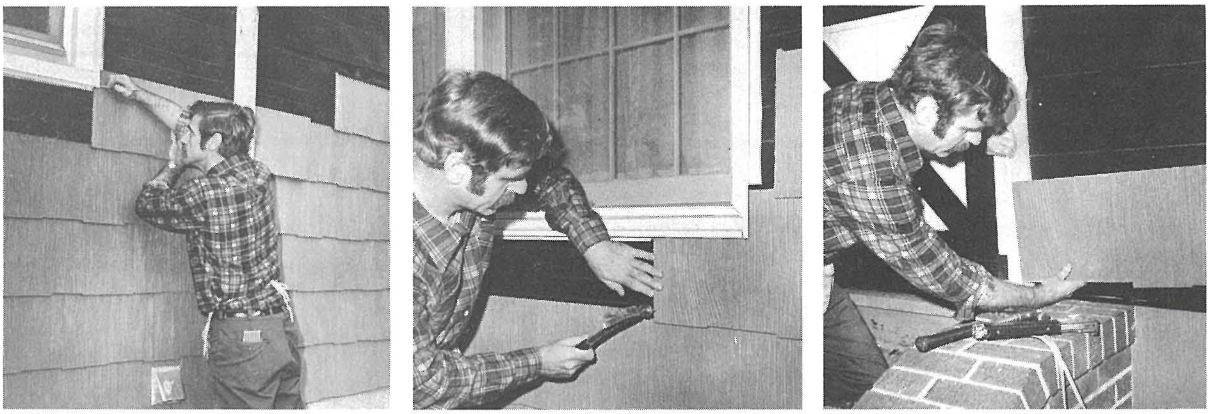


STAPLING 15-lb. alphalt-saturated felt over the old siding is the first step in installing the new material. Then nail wood lath below the butt edges of the old clapboards wherever you find them needed to provide a solid nailing base. Next, install corner mold at both ends of the wall run (top, right). To install a corner, drive nails through the trim's flanges into clapboard butt edges. Then apply double lath (lower left) to the lowest clapboard. A backing strip goes under each shingle end joint (bottom, center). A long level or chalkline serves to level the panel (bottom, right) and three nails are driven home. You're on your way.



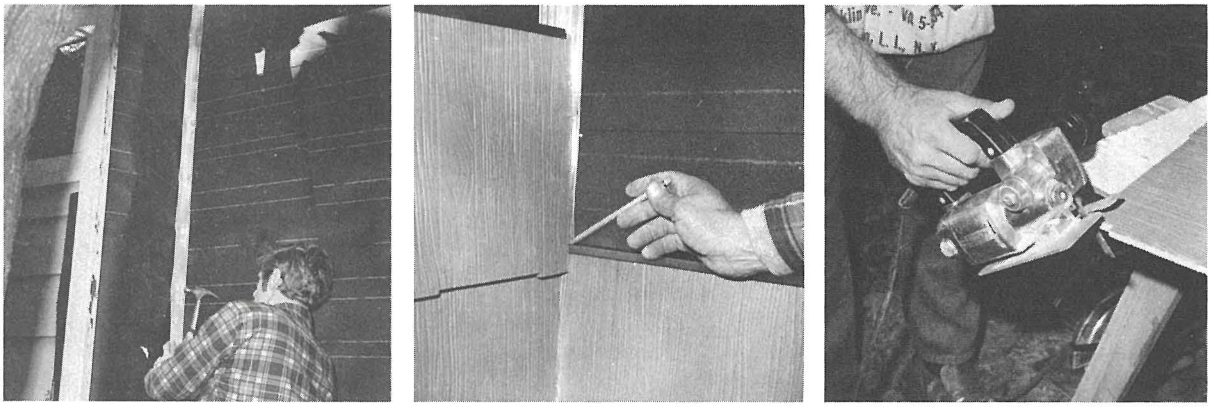
KICK-STRIP UNDERCOURSE, a special plastic shim strip to get an architectural shadowline under shingle butts (far left), sits atop each course. Just press it down firmly around the top of each shingle panel. To ensure staggered joints, start the first course with a full 48-in. panel. Then second and third courses start with half and quarter lengths respectively (near left).

Fitting siding around windows and doors

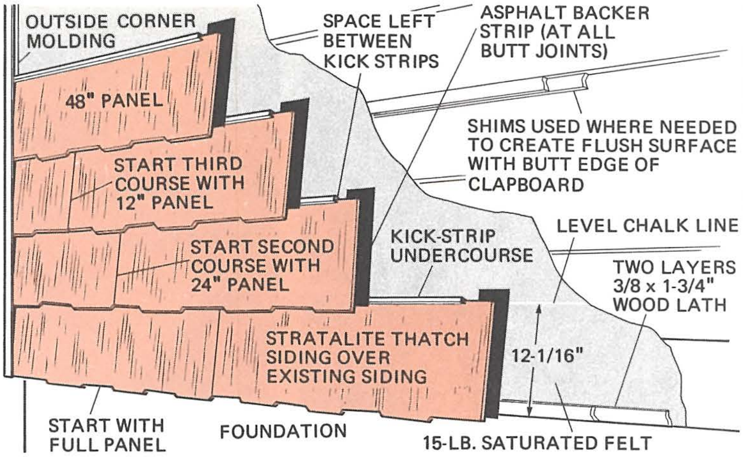


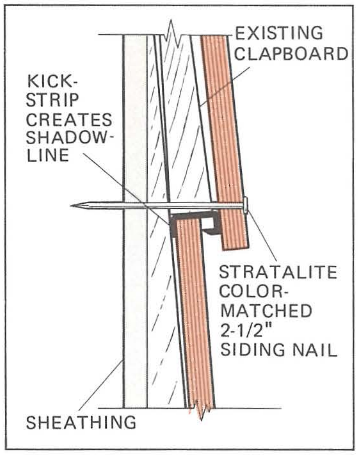
BEFORE SHINGLES go on, install J-channel on all casings around windows and doors (drawing, facing page). When you get to a window, you'll have to cut—and maybe notch—a shingle. Hold it in place and mark it for the cutting operation (left and center photos). Doors, as you'd expect, are treated in the same way (right).

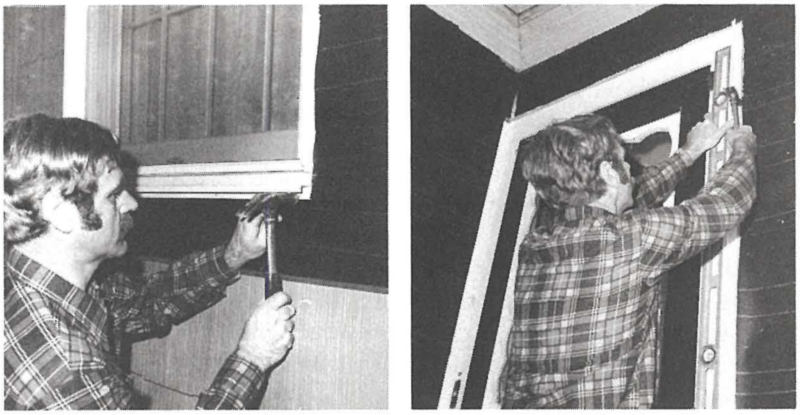
Scribing inside corners



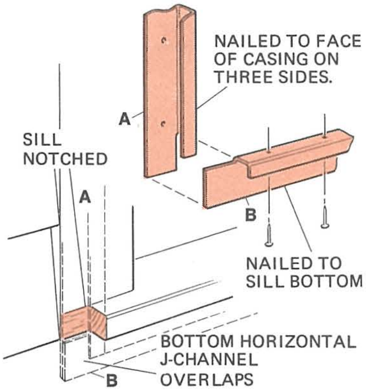
AFTER FELT IS stapled to the existing siding, nail aluminum flashing to inside corners, making a valley for any rainwater seeping into the joint. A corner shingle must be notched for the Kick-Strip it abuts (right). A dust mask would be good to use in cutting shingles; they're generally made of asbestos.


OUTSIDE CORNER MOLDING
48" PANEL
START THIRD COURSE WITH 12" PANEL
START SECOND COURSE WITH 24" PANEL
STRATALITE THATCH SIDING OVER EXISTING SIDING
START WITH FULL PANEL
FOUNDATION
SPACE LEFT BETWEEN KICK STRIPS
ASPHALT BACKER STRIP (AT ALL BUTT JOINTS)
SHIMS USED WHERE NEEDED TO CREATE FLUSH SURFACE WITH BUTT EDGE OF CLAPBOARD
KICK-STRIP UNDERCOURSE
LEVEL CHALK LINE
TWO LAYERS 3/8 x 1-3/4" WOOD LATH
12-1/16"
15-LB. SATURATED FELT


EXISTING CLAPBOARD
KICK-STRIP CREATES SHADOW-LINE
STRATALITE COLOR-MATCHED 2-1/2" SIDING NAIL
SHEATHING



NAIL FIRST J-channel to the sill's underside. Then bobtail the sill ends to accept the vertical channels, which go up next. A spirit level will help the work.


NAILED TO FACE OF CASING ON THREE SIDES.
A
SILL NOTCHED
A
B
NAILED TO SILL BOTTOM
BOTTOM HORIZONTAL J-CHANNEL OVERLAPS
B

NOTCH all J-channel ends; the horizontal (B) tongue slides into a notch in the vertical piece (A).

re-siding your house continued

A SECOND shingle is held in place and scribed to fit an inside corner.

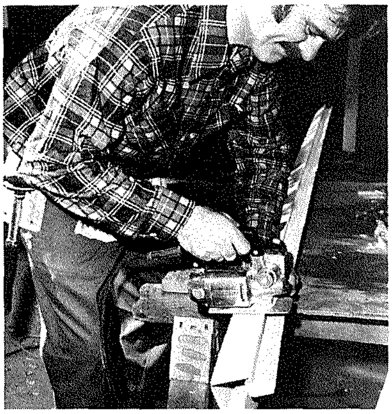
within two years of painting—despite the hours spent in preparation and painting and the high-quality paint used—meant this was the year for me to re-side rather than repaint.

There were several points to consider when choosing the siding:

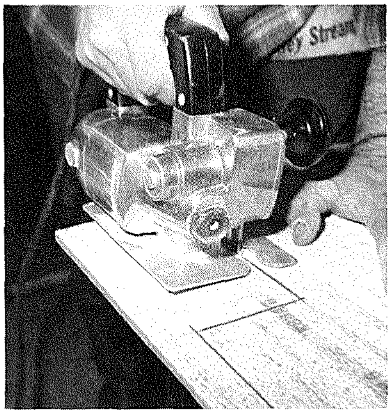
First, I wanted my home to present a woodlike appearance that *did not* look factory-made.

Second, due to limited time and equipment, the installation procedure had to be realistically within the range of a do-it-yourselfer.

Working with the materials



TO CUT metal corner moldings and J-channel notches, use a sabre saw with a hacksaw blade.



STRAIGHT CUT on a shingle is made from back. Carbide-tipped blade in a circular saw does best. Use a mask.

re-siding your house, continued

Third, also due to limited time, the siding had to be prefinished.

I briefly entertained the notion to let someone else do it for a change, but price quotes ran from $3000 to $5000, depending on the particular siding the contractor was pushing.

So I decided to do-it-myself with Stratalite Thatch siding S-120 from GAF. This mineral siding, in 1x4-ft. panels and nine colors, is sold in "squares," quantities that cover 100 sq. ft. Color-matched installation nails and Kick-Strip undercourse (which is shown in photos and drawings) are included in the price.

Measure the house for the amount needed. The procedure: Add up the square footage of outside walls and subtract the footage of doors and windows. In my case that came to 20 squares; adding 10 percent to compensate for waste, I ordered 22.

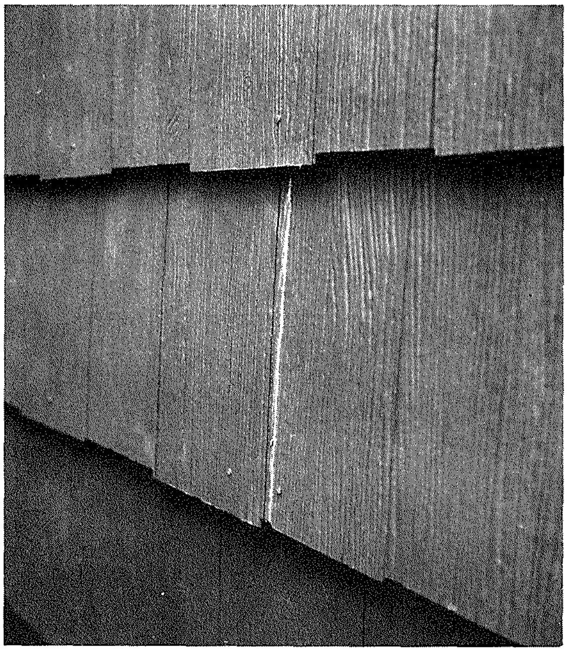
The total cost of my job was $1027. Siding cost $792; scaffold rental was $75; and felt, staples, galvanized nails and wood lath totaled $60. Metal corner trim, J-channel and the like ran about $100. The best contractor bid I'd received for the job was based on lower quality materials. But compared even to that "low" price, I saved close to $2000.

It was well worth the five weekends or so of hustling around.

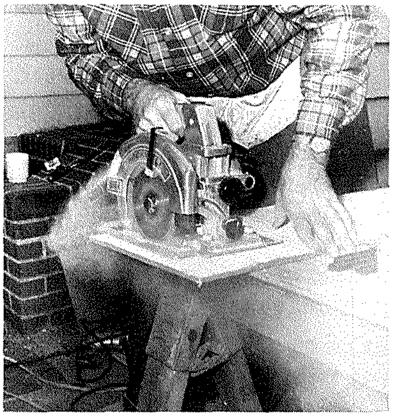
As these illustrations show, the material is easy to work with, although I'd have been smart to wear a dust mask any time I used a power saw on mineral siding. It's made of asbestos cement and the dust is now recognized as carcinogenic.

The trickiest part is putting J-channel around

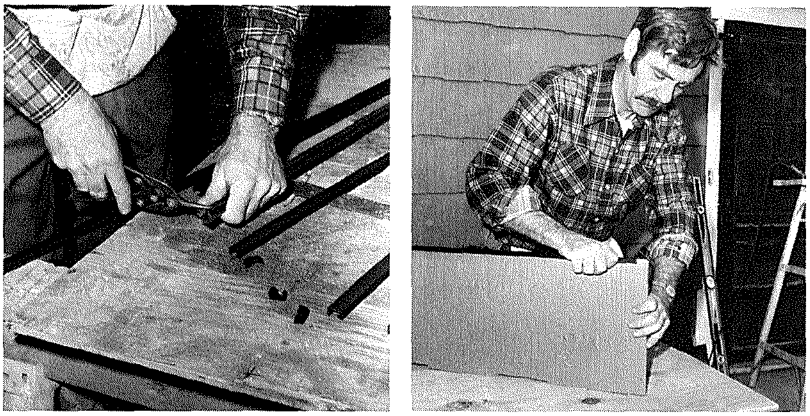
The finishing touch



WHEN A SHINGLE must be cut, a thin white line shows up. Matching touch-up paint hides it well.

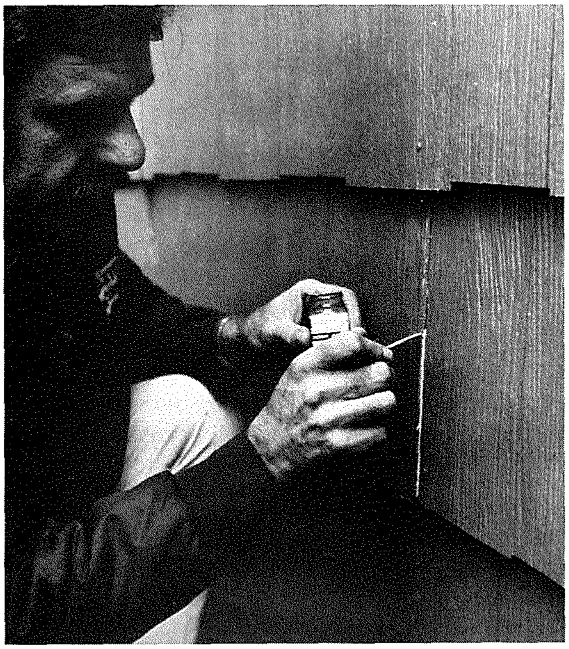


WHEN cutting a shingle, support it fully on a plywood table. Set the blade barely to clear the work.

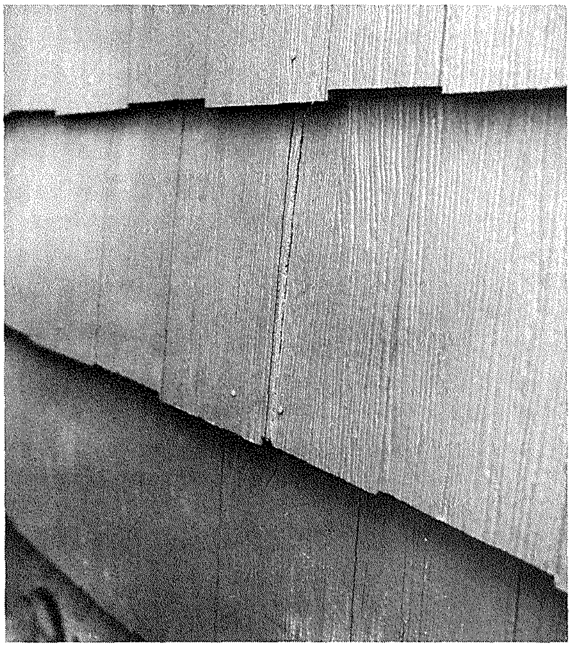


A CUT SHINGLE-TOP means the Kick-Strip must be trimmed too. Strips must have a gap to allow for thermal expansion. You needn't cut sections for long runs. Just press them onto the shingles after the course is nailed up.

windows and doors. If a neighbor has recently added aluminum siding, check it closely. It probably went on with a similar system. Remember that the bottom horizontal goes *under* the sill, so sill ends must be sawn off to clear the vertical channels. The drip cap at the top comes off, too; J-channel replaces it. For more information, you can write to Building Products Div., Dept. PM, GAF Corp., 140 West 51st St., New York, NY 10020.



SPECIAL TOUCH-UP paint goes a long way; this little jar was enough to cover all the joints.



THE PAINT matches the shingle finish. Keep it in your nail apron and do joints as you reach them.

How to get started in skin and scuba diving

By DICK JACOBY

SHIPWRECKS lying mysteriously on the ocean bottom. Brilliantly colored damselfish darting through slowly undulating soft corals. The breathtaking configurations of giant sponges.

These are just some of the experiences awaiting the new skin or scuba diver. Every year more than 200,000 people take up sport diving, and you can be one of them, providing you're in good health and you can swim on the surface reasonably well.

There are two kinds of sport diving. Skin diving requires only a face mask, a snorkel and fins, and can be taken up without any formal lessons. Scuba requires a compressed air tank carried on your back. This allows you to dive to greater depths, but it also demands special skills and techniques and therefore should not be attempted without first completing classes.

How old should you be? Diving organizations will teach children as young as eight years old to skin dive. And a child of 12 may be taught to use compressed air scuba equipment if accompanied in the class by an adult. Age 15 is generally the minimum required to take a standard scuba course.

First, you'll need the basic gear: a mask so you can see underwater, a snorkel to breathe through, and a pair of fins. You can buy these things at specialty stores called "dive shops." Some major retailing and sporting goods chains also carry diving equipment.

Remember that fancy doesn't always mean better. Among many varieties of face masks, for example, a simple oval plate of tempered glass that covers your eyes and nose works well for most people. A handy feature is a nose pocket molded into the bottom of the mask's rubber skirt. The pocket makes it easy to hold your nose and "pop your ears" by trying to blow out—an excellent way to prevent your eardrums from being squeezed by water pressure.

SEE ALSO
Underwater photos . . . Water skiing

To check a mask for fit, position it on your face without putting the strap around your head. Now suck in through your nose and let go of the mask. You have a good fit if suction holds the mask in place.

Your snorkel should be of ⅞-inch bore and be made of semi-rigid rubber. Make sure the barrel has no sharp turns or ridges that could hamper air flow. Avoid snorkels with flexible tubes; the air turbulence created by the corrugated rubber makes for difficult breathing.

Start with fins of medium size. You'll want ones that are fairly flexible to prevent cramps in your calves. Also consider whether you plan to dive exclusively in the tropics. Why? Because water temperature will play a part in determining the kind of fins you use. If you expect to dive in water below 75 degrees, you'll probably need a quarter-inch-thick foam rubber body suit to keep warm. The suit includes boots, which is why you will want fins with half-pockets large enough to include thick foam rubber boots. A heavy adjustable strap on each fin stretches around the heel and holds the front of your booted foot in the pocket.

If your diving will be exclusively the warm-water kind you may prefer smaller fins that have full pockets. The smaller fins are easier to use, too, if you are new to diving and your calf muscles aren't built up.

A flotation vest is a good idea when skin diving far from shore. It's a tough bag of rubberized nylon worn around the neck and strapped to the front of your chest. To inflate, you blow into a hose or release carbon dioxide from a disposable cartridge. You deflate by depressing a finger valve.

A weight belt may help you dive 10 or 20 feet while holding your breath, and becomes even more important in scuba diving. Lead weights slip on a two-inch-wide belt of nylon or rubber. The belt has a quick-release buckle so you can drop it in an emergency. You'll need between two and 20 pounds of lead, depending on where you dive, what you wear and your body build.

You can learn to skin dive in any body of quiet water larger than a bathtub. Just stretch out on the surface and you'll experience the thrill of seeing clearly underwater while expending virtually no swimming effort. Breathing is a snap because the tip of your snorkel sticks a few inches above the surface while the other end is held in your mouth. Now kick your feet with long, slow leg movements. Don't use your hands to propel

YOUR FIRST GLIDE through the coral-filled ocean will thrill you with its beauty and a feeling of flying.

WITH A LITTLE practice you can swim right up to a school of French grunt. The secret is to swim very slowly.

you; your fins multiply the surface area of your feet at least five times and thrust you through the water far more efficiently than standard swimming strokes.

It's a good idea to inhale slowly when swimming in choppy water because a teaspoon or two of water may wash into your snorkel. Blast the water out by inhaling gently and then giving a sharp puff.

A short skin-diving course is always useful. You will learn to remove water that leaks into your mask, practice alternative fin kicks and learn how to control your buoyancy so you can float or dive at will. Safety methods are also taught, the most important of which is the habit of always diving with a buddy.

A delightful way to learn skin diving is to combine your lessons with a tropical vacation. Most warm-water resorts employ a staff of experienced divers and instructors who will spend an hour or so in a pool to teach you diving basics. Then they will guide you to shallow coral reefs to test your skills.

Your first sight of a coral reef and its brilliant

THERE'S NOTHING like the exhilaration of an ocean dive. Thousands of Americans take diving vacations each year.

GEARING UP for a dive requires attention to detail. A "wet suit" goes on first when the water is cool.

fish will be one of the most memorable experiences of your life. Amazingly, you are the stranger to be stared at as you rest motionless on the surface or dive briefly the few feet to the coral below. The thought will surely cross your mind: Why not learn scuba diving in order to remain submerged with these beautiful fish?

scuba gear and instruction

''Scuba'' actually stands for Self-Contained Underwater Breathing Apparatus. A compressed-air tank is worn on your back and air is fed to your mouth through a regulator. To breathe, you simply inhale and exhale and the demand regulator does the rest.

Scuba gear is virtually failsafe. Still, scuba diving should never be attempted without formal lessons, and since there are several brands of scuba equipment and features to choose from, you'll want the advice of your diving instructor before buying. The instructor can also give you a chance to try several models before you make your final selection.

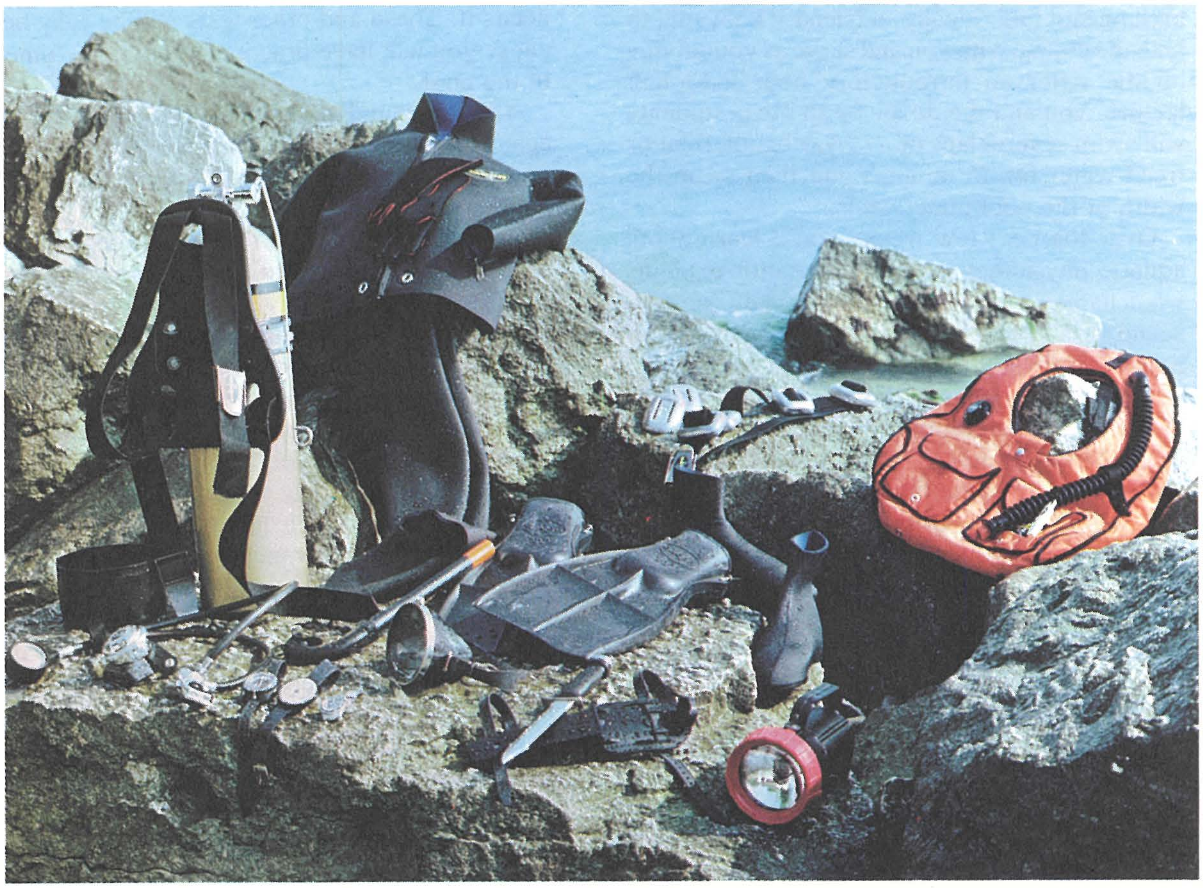
Scuba diving is classified as a safe sport by the President's Council on Physical Fitness, mainly because such good teaching is available in the U.S. Those who teach scuba must undergo rigorous training, and many don't make the grade. Make sure that the instructor you choose is a member of either the National Association of Skin Diving Schools (NASDS), National Association of Underwater Instructors (NAUI), Professional Association of Diving Instructors (PADI), or the YMCA.

Prices vary, but to give you an idea of cost, a Chicago area dive shop offers a 35-hour course for about $85. It lasts from 9 to 12 weeks and includes 15 hours of pool training, 15 hours of classroom lectures and three training dives in open water.

what happens in a scuba course?

Okay, let's say you've found a certified course that fits your schedule. Here's what it may be like:

A FULL SET of scuba equipment. Clockwise from 12 o'clock: weight belt, buoyancy compensator, boots, dive light, knife, fins, mask and snorkel, dive watch, depth gauge, tank boot, tank and backpack, wet suit top, gloves, pants and hood. Price runs $600 and up, depending on features and sales discount.



YOU SHOULD always dive with a buddy and wear a flotation vest when you use scuba. In this way there will always be someone to help out in any rare emergency.

You'll arrive at your first meeting (well rested, we hope) with three things—writing material, a bathing suit and, ideally, a friend who wants to take the course with you and serve as your diving buddy. After an introductory hour-and-a-half lecture, you and the dozen or so other students will swim several laps of a 25-yard pool, float or tread water for 15 minutes and then swim the width of the pool underwater.

Over the next few weeks you'll learn about aquatic physiology as your instructor explains what happens inside your body when you descend 30 or 40 feet beneath the surface. You also need to know a little physics, and your teacher will show you how a high-pressure air cylinder connected to a deceptively simple set of valves in a regulator makes it possible to breathe underwater for more than an hour.

You'll learn how to prevent pressure-related medical problems such as "ear squeeze." And you'll find out that "rapture of the deep" is actually nitrogen narcosis, in which too much nitrogen pressure causes a diver to become irrational. (To minimize this problem sport divers should not dive deeper than 100 feet.)

Most people have heard of the "bends," or decompression sickness, and your instructor will explain how nitrogen pressure again is the culprit. Most likely he will distribute U.S. Navy diving tables so you can memorize how long you can spend at any given depth before your body absorbs so much nitrogen that it turns into bubbles when you ascend.

You'll learn how to use and maintain your scuba gear, how to take it off and put it on while sitting on the bottom of the pool, and how to get yourself and your buddy out of jams that sometimes, albeit rarely, happen in sport diving.

At the end of, say, 12 weeks you'll be given a written test and a pool test to demonstrate both your knowledge and your diving skills.

at last . . . into the deep

Now comes the real fun: a weekend of supervised diving at a popular location. First, everyone will make a general swimming tour of the area while demonstrating his skin-diving skills. Then, with an instructor, you will scuba dive about 30 feet and show that you can control yourself and your equipment beneath the surface.

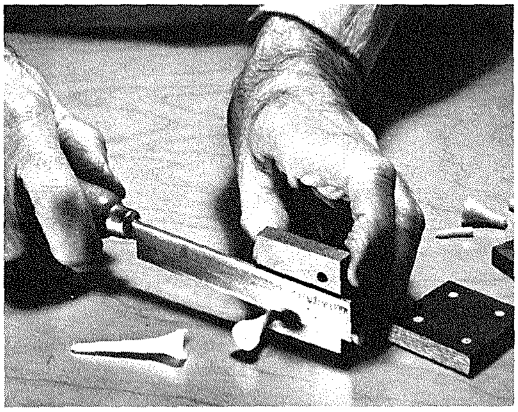
Underwater you'll have to remove your regulator from your mouth and then replace it. You'll let water into the mask and then force it out by blowing through your nose. The instructor will probably have you share your regulator with him to simulate giving air to a buddy who needs it. These and other tests will be easy because you will have practiced them many times in the pool.

After a rest and a light lunch, the class will dive again, this time with less supervision. Perhaps you will all expand your skills by navigating a compass course.

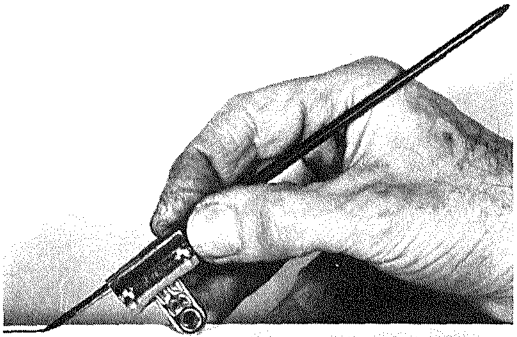
Sunday is a free day. Your instructor and assistants will be around to help, but now you and the class will be virtually on your own. After the sun goes down the course will culminate in a graduation dinner. Along with a Certification Card (called a C-Card), the instructor may give each of you a logbook in which to keep track of your diving experiences.

The C-Card is really a license to learn more about diving, and your instructor may tell you about the various advanced courses now available to you.

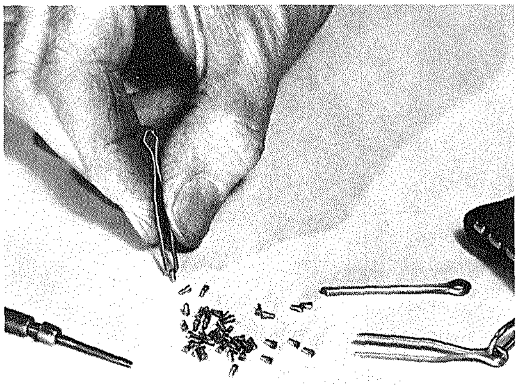
Your future in diving will expand as exploration of the deeps grows beyond its present infancy. You may even consider becoming a professional diver (in which case you'll find good money and hard work). But whether you dive for sport or career, you'll be joining the vanguard of pioneers who explore that layer of water that covers three-quarters of our planet—the inner space of the future.



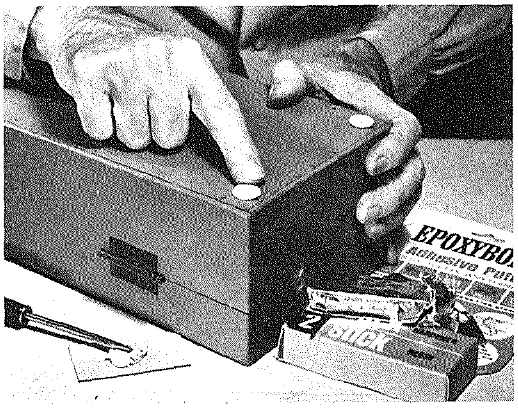
EXPENSIVE IVORY inlays can be simulated for pennies with plastic golf tees. Roughen a tee stem with sandpaper and drill a hole slightly smaller than the top of the tee. Apply glue to both the stem and the hole; drive the tee into the hole, then cut off the projecting portion near the surface. Use a file and fine-grit paper for final smoothing.



A GOOD STRIPING JOB requires a keen eye and a steady hand. If your artistic talents are a bit below professional level, simplify the whole operation by clamping the brush in a small clamp-type paper clip. The handles slide along the edge of the work and straddle the pattern line; they also form a moving pivot for the brush, making it much easier for you to maintain the proper angle between brush and surface for a stroke of desired width.



IT ONLY TAKES a couple of minutes to turn a cotter pin into a miniature pair of tweezers. First, file the ends even. Next, file the tips to the desired configuration, either a flat spade end or a blunt point. Finally, bend the ends of the legs approximately ¼ in. apart, making sure the loop remains almost completely closed so you can slip it over a key ring or other holder. A slight opening in the loop will make the tweezers easier to use.



EPOXY ADHESIVE PUTTY can be used to make button-type glides for index boxes, small cabinets and other objects which normally sit on a table or workbench. Simply mold a ball of the putty to shape with your fingers and press it into position on the bottom of the cabinet. Allow plenty of time for it to harden before turning the cabinet upright. With wood cabinets, you can add extra holding power by first driving tacks into the bottom and compacting the putty around the heads.

How to take care of your skis

Proper bottom maintenance puts skis in top shape and keeps them there during off-season and on. Here's advice from experts, for all types of skis, on the best ways to wax, transport, store, file edges, and repair deep gouges and scrapes

By JACK VAN VLECK

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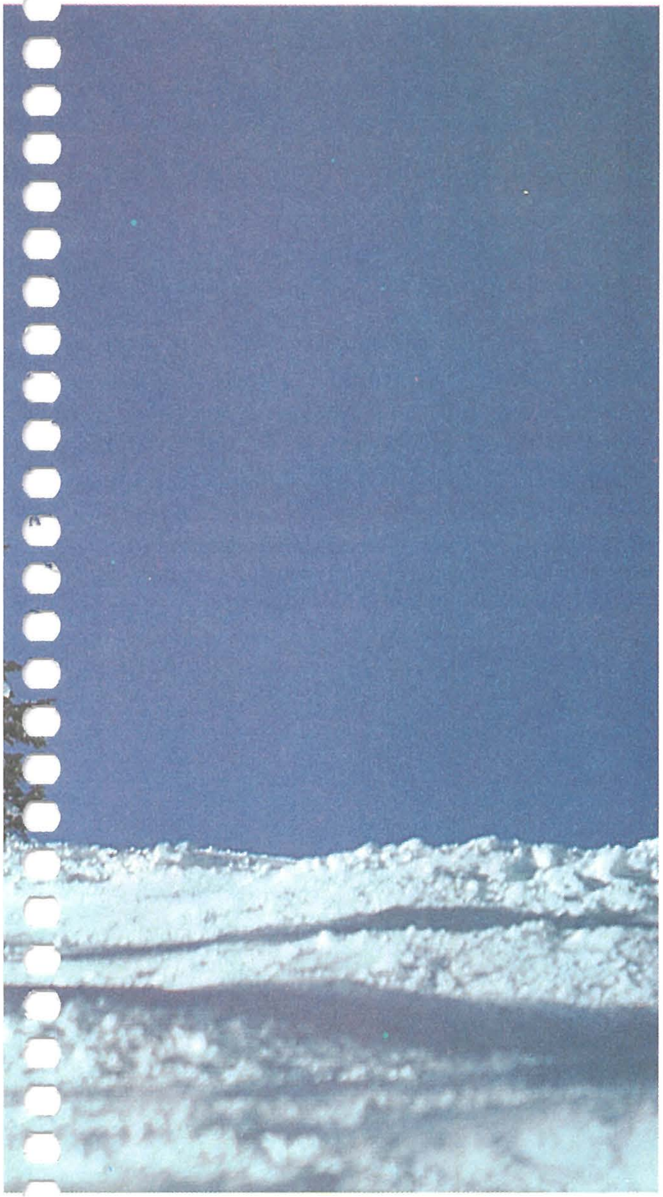


■ YOU CAN WHANG UP even the toughest pair of skis, no matter what they're made of and no matter what the salesman says. Even the best equipment, worn by a downhill expert or touring novice skier, is subject to scraping, crossing, bottom gouging, edge dulling and burring. If you believe the "maintenance free" stories you're going to shorten the life of your equipment. And at a steep price tag for some of today's top-design FRP (fiberglass reinforced plastic) "schusslatzen" for instance, you'll be throwing away money if you skip the simple preventive maintenance that keeps skis going in winter and safely stored off season.

"Proper waxing tops your checklist," says Garcia Ski Corp.'s Jeff Garluck. Waxing comes after the edges have been sharpened (since filings can become embedded in paraffin) and can be done hot or cold. Satisfactory cold methods include the old rub-on stick wax technique as well as more modern paste and spray treatments. Cold waxing is easy and convenient, especially for touch-ups on the slopes, and should be done a couple of times during the ski day, often matching wax type to snow conditions.

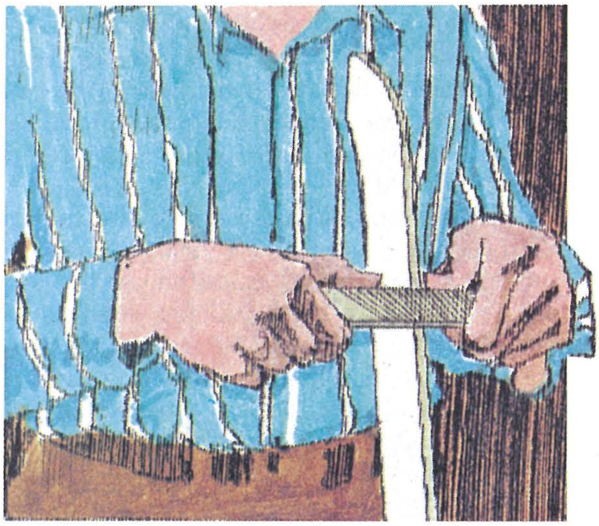
Hot wax coats, applied by iron-on or paint-on methods, last longer. An iron at medium heat is held, point down, over ski bottoms and wax pressed against it until the wax melts and can be dribbled down one side of the ski, outside the groove, and up the other. Ribbons of wax are ironed out evenly over the entire surface—keep the iron moving so the base won't loosen its bond with the ski. Afterward you'll have to buy your wife a new iron, of course.

To paint on wax, melt it in an old pot and with a ski-width brush dip in and then press out any bubbles against the pot. Paint skis from tail to tip in 18-inch overlapping strokes. After any hot-process application, scrape the cooled coating, tip to tail, to even the finish. A knife or coin can scrape the center grooves. Use plastic or wood to clean edges.

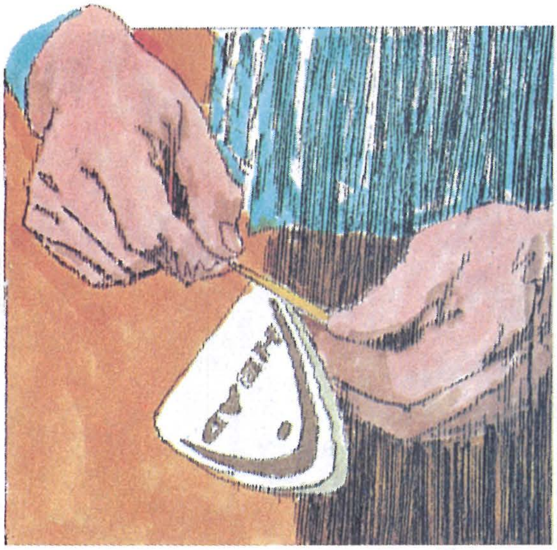
transporting skis safely

Waxing keeps polyethylene bases from wearing down quickly, prevents oxidation, helps turning by avoiding tip-scrape. Tops of skis can use car wax to help guard against road salt when skis are carried on exterior racks. Northland's Jerry Gruggen notes that almost as much minor damage can happen while toting equipment as during actual use. Off the rack, skis should be carried bottom to bottom and strapped together to prevent edge scissoring. Transporting them inside the car is dangerous to skis and riders in case of a sudden stop. When using a public carrier, "Box your gear or use a ski bag," says Blizzard spokesman Frank Moran. Wrap newspapers between skis to avoid marring waxes' bases. Bagged in canvas, burlap or plastic on a roof rack, skis are protected from flying stones, ice and road salt.

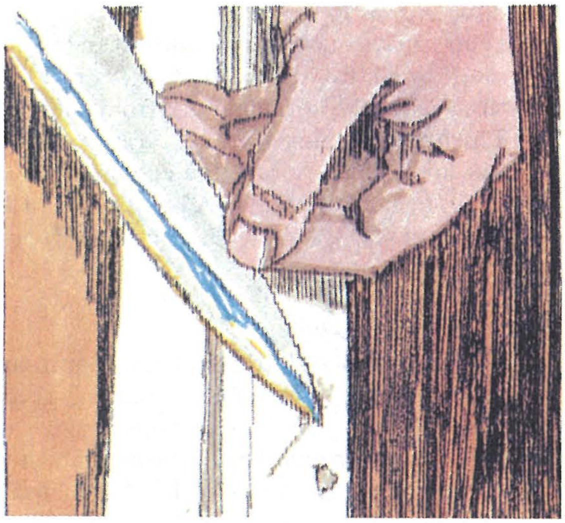
Store skis vertically in wood racks at ski areas and at home so snow can drain off and no one will trip over them. When finished for a weekend—or season—wipe skis dry, wax tops and bottoms lightly and coat edges with light oil or Vaseline. Modern skis don't need to be blocked in the



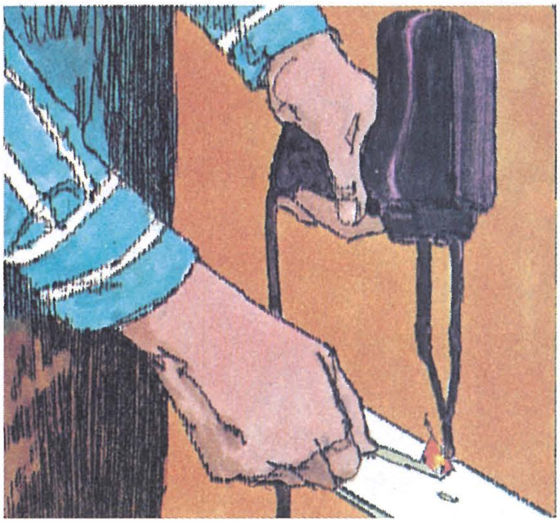
SHARPEN SIDE EDGE with flat No. 10, removing rough spots, nicks. Result should be even edge that forms 90° angle between bottom edging surface and side.



TIP EDGING of ski should not be sharp. Starting even with front end of center groove, round edging forward toward "shovel" tip to prevent tip-tripping.



DEEP GOUGES require more than waxing to fill and repair. First use knife or other sharp tool to dig out any loose foreign matter before starting repair.



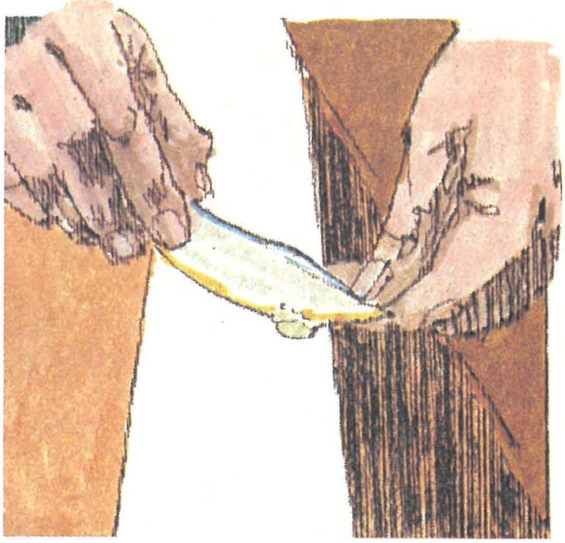
FOR BEST BOND, a clean soldering iron is used to heat base around gouge edges. Molten repair-stick "spaghetti" is dripped in. Extinguish burning drops.

middle to maintain camber, but should be stored away from temperature extremes. Strap together and suspend from cellar beams or closet hooks. Wall racks from ski stores are good. Rest ski tails on wood blocks rather than concrete floors.

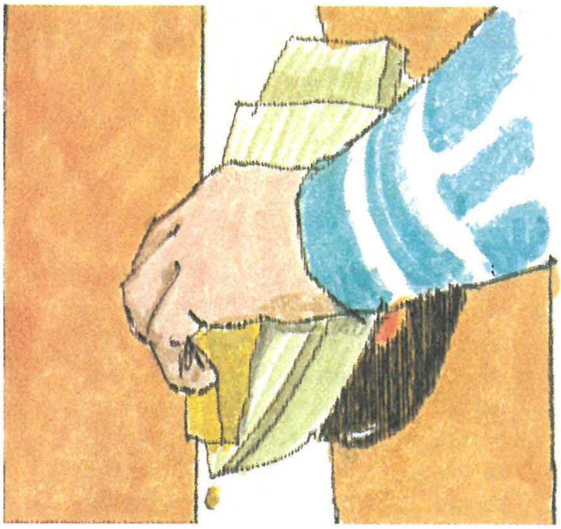
Edges and bases take the worst beating. After each trip, knock off edge burrs with emery paper or a file. Run your fingernail crossways over the edges and bottom. If it sticks against an edge, you have the start of a "railing" problem—bottom wear has exposed the inside steel edge corners. To remedy this and other edge faults yourself, get a No. 10 flat crosscut mill bastard file. Then clamp your skis, one at a time, base up in a vise.

Lay the file flat on the base and angled about 45° in the direction the ski is pointing. Keep weight on your thumbs at the middle of the file and push easily in long strokes down the length of the ski. Don't shift pressure to file ends or press hard. You're working for a flat-edge surface flush with the base. If the base is worn too far, you'll have to build it up with layers of wax.

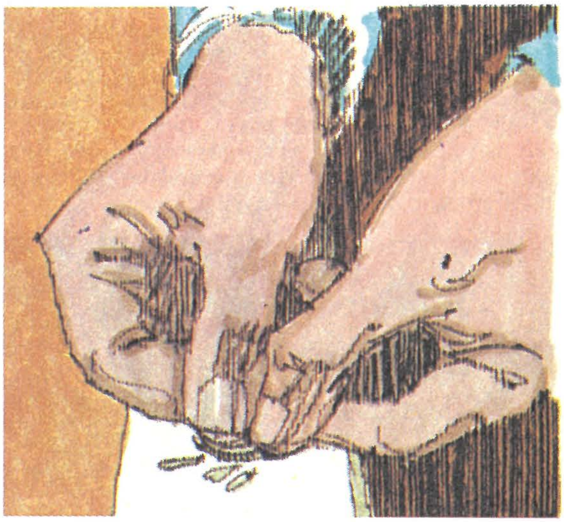
Next, clamp the ski with one edge up. File the ski edge flat down the ski length to get a 90°-angle edge flat on the base and the side. At the front, from a point parallel to the groove end, bevel the



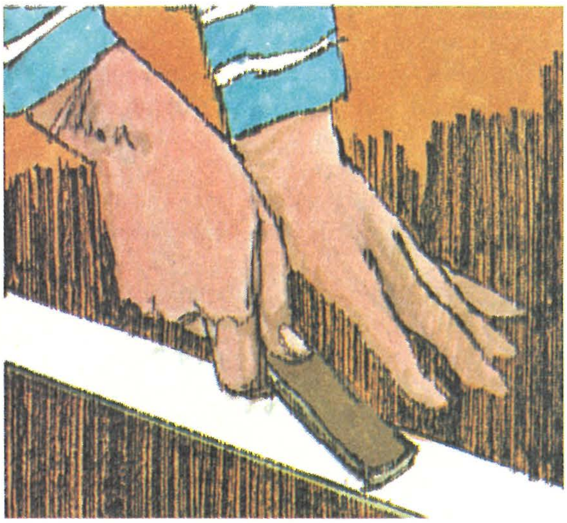
SHAVE OFF excess polyethylene with knife or metal scraper to bring fill down to ski level. Use repair sticks without soldering iron for field patch.



IRON-ON WAX METHOD uses wax held against iron at medium setting. Drips from iron are dribbled on surfaces each side of groove, ironed out smooth.



CENTER GROOVE is scraped out and smoothed with coin or knife. Wax runs in during ironing. Keep hot iron moving over bottom during smoothing of wax.



PEEL WAX from edges with plastic or wood scraper to guard against scratches. Full surfaces of the ski are then leveled with metal scraper for even coat.

edging as far as it runs up the "shovel" (tip).

Deep gouges and scrapes caused by "fast grass and rock garden" conditions need special attention since moisture can work into holes and start delamination. Kofix or P-Tex candles (often called spaghetti) are the answer, and come in colors to match your ski bottoms. Clean base with a rag and benzine or a brass pot cleaner (never use steel wool). Heat damaged area with a clean soldering iron. Split repair candle (for smaller drips), light and drip melted polyethylene into gouge until it's higher than base layer. Smooth cooled material with knife or gadget like Stanley Pocket Surform. Very gently sand patched area with fine sandpaper, rewax as usual.

Today's fancy top ski surfaces can be scratched, "but that won't affect performance," says Ron Guisick of Hart Skis. "The melamine (finish coat) can chip but good skis have plastic or metal strips running along the outside edges to prevent excessive damage if skis cross during a run." Scratches can be sanded and waxed.

Your warranty may require professional repair for major damage like delamination or edge separation. But most modern skis can last a number of seasons with minimum—but regular—basic maintenance.

Slim those old skis for cross-country

By PHILIP HERMANN

THOSE OLD WOODEN skis gathering dust in a closet can be recycled into handsome and useful cross-country touring skis for a few dollars.

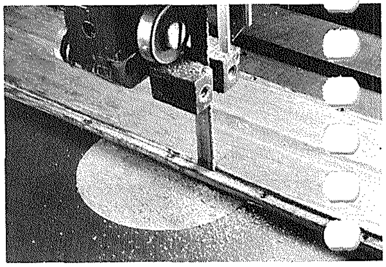
Old downhill skis weigh as much as 12 pounds a pair, averaging about 82 inches (210 cm) in length and nearly three inches (70 mm) in width, much too wide and heavy for a long hike over the snow. It's not difficult, however, to remove weight while retaining the original length and strength. New cross-country skis vary from the ultralight 3-pound, 2-inch-wide (50-mm) racing pairs up to the 7-pound, 2½-inch (65-mm) models. After refinishing a pair of your old downhills, they should fall roughly into the category of a general touring ski.

First customizing step is to strip the old skis of all metal edges and bindings. Save these for future use. The rabbet groove where the steel edge is removed is an excellent guide for sawing off unneeded wood. This trimming will reduce the ski width by about ½ inch or 12.7 mm. The combined removal of steel edges, screws, and excess wood can save as much as two pounds per ski.

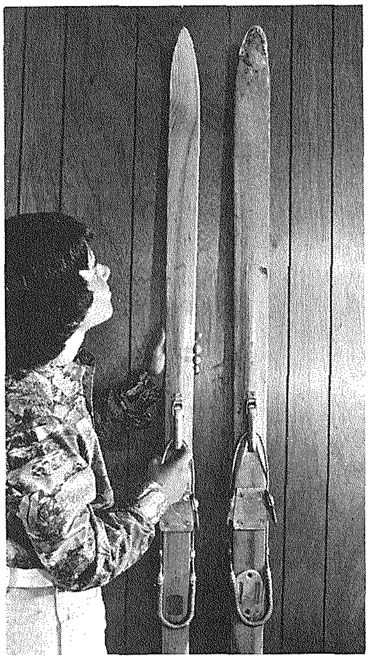
The rough-sawn edges can now be smoothed and the tips reformed with a block plane. A 10-inch double-cut file will smooth out any abrasions left on the edges. This final filing also helps form sharp edges along the sole of the ski and a rounded edge on the top. Layers of wax, varnish or paint can be removed with a cabinet scraper, and the groove in the bottom of the ski scraped clean with a coin. Follow the scraping with thorough sanding with No. 50 sandpaper, then No. 120 paper.

Grundvalla, often called pine tar at ski shops, is next applied as sealer and base before you wax ski soles. Brush a thin, even coat on each ski bottom. It will penetrate as a propane torch flame is passed over the surface until the tar bubbles and dries. Keep torch in motion so no wood is singed. Rub with a rag after burning in the tar, and remove any warm excess tar.

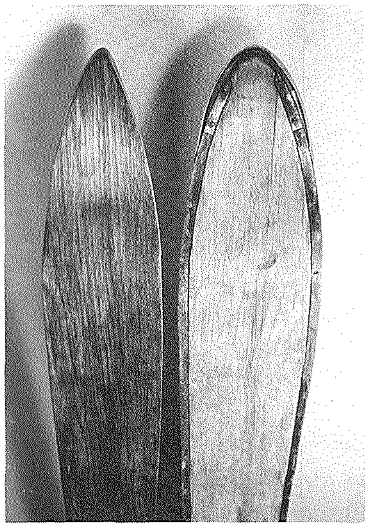
Stain the ski tops if a darker color is desired, then finish with two coats of clear polyurethane. Your old cable "bear trap" bindings clean up easily with naval jelly and work quite well with old flexible boots. For walking, run the cables through the front heel clips instead of the rear ones to give more freedom of movement.

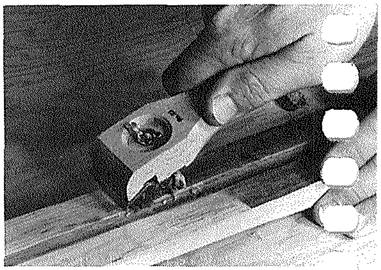


YOUR CUTTING guide for narrowing skis is provided by rabbet slot where metal edgings were removed.

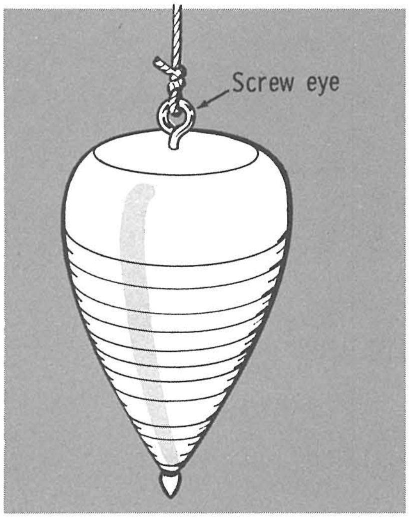


SLEEK TOURING ski on the left (left photo), for newly popular cross-country, can be trimmed from old Alpine on the right. Rough saw cut (right photo) is smoothed off with block plane to reshape the tip and achieve straight, right-angle edges.

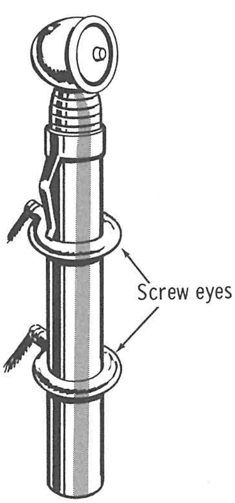




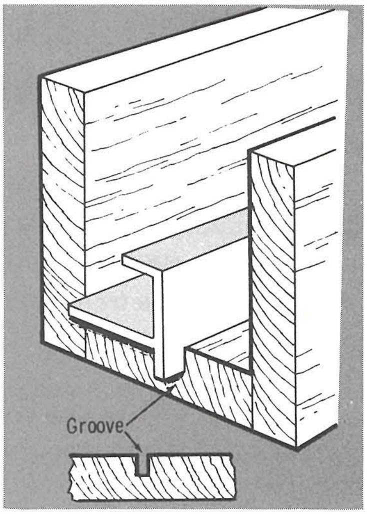
NEW AND old tips (above) show the handsome slimming and streamlining of the recycled ski on left. Filing makes sharp bottom edge, round top. Bottoms (above, right) are cleaned with a sharp furniture scraper until all old wax, base and varnish are removed. A coin edge cleans groove. Pine tar (right), a wood sealer and wax base known as Grundvalla is applied to bottom with small brush, burned in to penetrate with a propane torch.



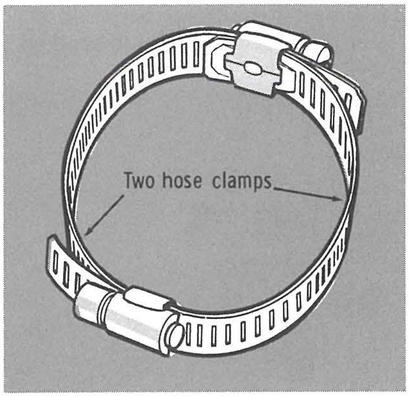
A TOY TOP can be turned into an effective plumb bob by drilling a small hole in the center and driving a screw eye into it. Tie a string to the eye and your "plumb top" is ready for use. A couple of nuts placed over the cord will add weight.



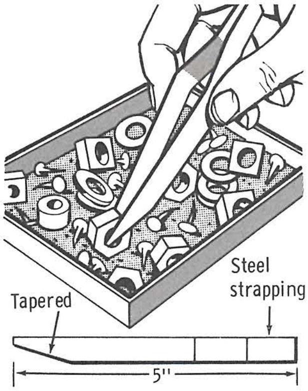
YOU WON'T HAVE to hunt for the pressure gauge to check cold tire pressures at home if you make a simple rack to hold it. Just drive a couple of large-diameter screw eyes into a garage stud. The spring clip will keep it from falling through.



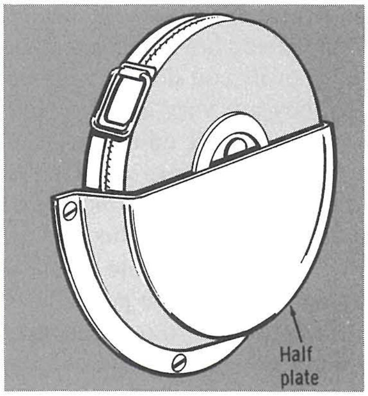
SOME METAL moldings have no flat side so you can't seat them properly in the miter box to cut an exact miter. It will pay you to make a special box with a kerf down the middle, or add a second bottom to an existing box to hold the molding flat.



WHEN YOU NEED a large hose clamp and one isn't available, try hooking two smaller clamps together as shown below. Don't forget that you'll have two screws to tighten instead of one.



IT'S EASY to cut a finger when rummaging in a box of small hardware. To avoid this, make up a pair of tongs from a steel strip of the type used to reinforce packing cases. Taper ends, smooth edges.



A SHALLOW plastic dish cut in half and mounted on the shop wall provides an ideal storage pocket for your steel measuring tape. Drill holes in the rim and secure it to the wall with three screws.

Trim the fat from your slide shows

By LEN HILTS

Stop boring your friends and relatives with hours and hours of dull slide presentations. Learn how to trim redundant slides from your presentations

■ WHEN YOU BRING OUT your slide projector after dinner, does everyone suddenly remember previous engagements and make for the nearest exit? If they do, you aren't alone. Too many avid slide shooters have bored audiences for so many years that the home slide show has developed a bad reputation.

What makes a slide show boring? It isn't the quality of the slides, as a rule, but it is the *quantity* of them. Most slide shows present far too many pictures—often running to half a dozen different views of the same scene—and they kill the audience interest by sheer weight.

Therefore, the first rule in preparing an interesting slide show is: *Trim out the fat*. Line up the slides from your trip during your editorial session and remove those that are duplicates or near duplicates. For example, one or two shots of the Eifel Tower are sufficient; you don't need six views of it; you don't even need two views unless they are very different in nature.

While you are editing out the duplicates, also get rid of shots that are out of focus, tilted, or that otherwise aren't good pictures. Don't throw any of these slides away. Just put them into a storage tray. You may be able to use the duplicates or salvage some of the poor shots later. They just don't belong in your presentation to the public.

After you have eliminated the poor and duplicate shots, arrange the remaining slides as you intend to show them. For a trip, chronological order is the usual way, but sometimes you can be clever by arranging flashbacks or other devices to heighten the viewer's interest.

Place the slides, arranged as you want them, into a tray and project them for yourself—but this time, be extremely critical. Edit so that the

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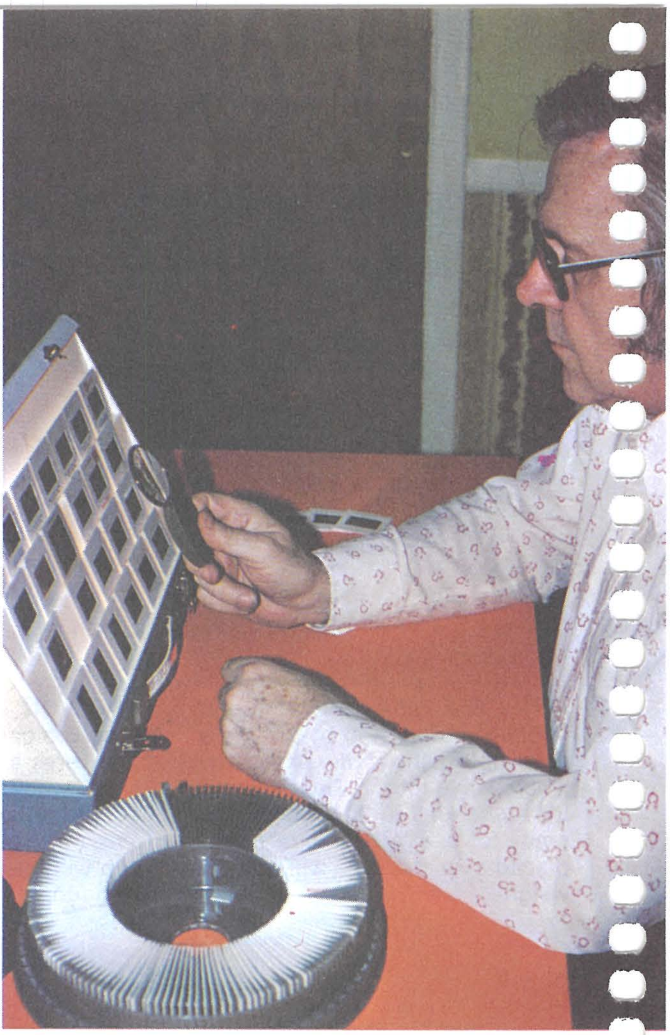
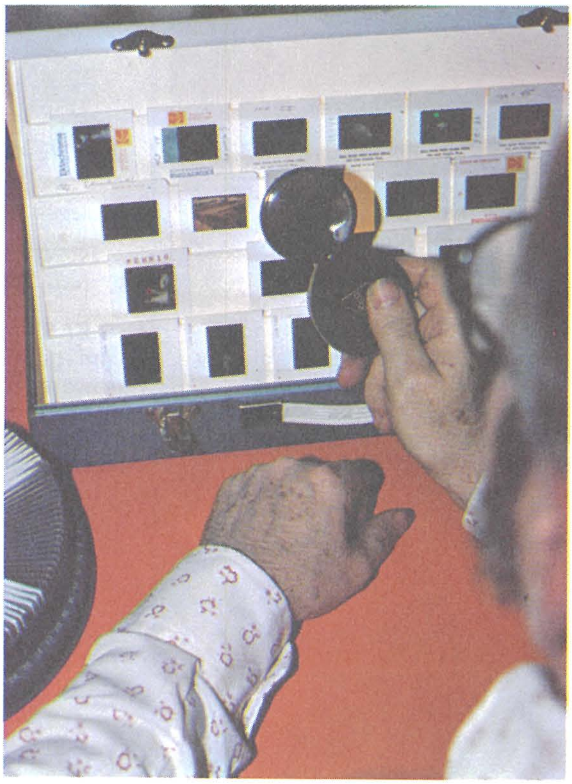


A SLIDE SORTER with a built-in light to assist in editing your slide shows is a must if you intend to get rid of unwanted shots. A magnifying glass helps in spotting photos which are out of focus.



show has pace—seems to move right along—and has a high interest level. Ruthlessly take out slides that slow down the pace, even though you think they are marvelous pictures. The saddest line of narration comes when you say to your audience, "This slide doesn't really belong here, but I wanted you to see. . . ." You can hardly hear your voice over the noise of the audience yawning when this happens.

The best tool for preparing a slide show is a slide sorter of the type shown on page 2796. You can display several dozen slides at one time on the white plastic front of the sorter, and see each clearly because of the light mounted behind the front.

As you edit, examine each slide through a fairly powerful magnifying glass. You can spot those that are out of focus or poorly composed without going to the trouble of putting them through your slide projector.

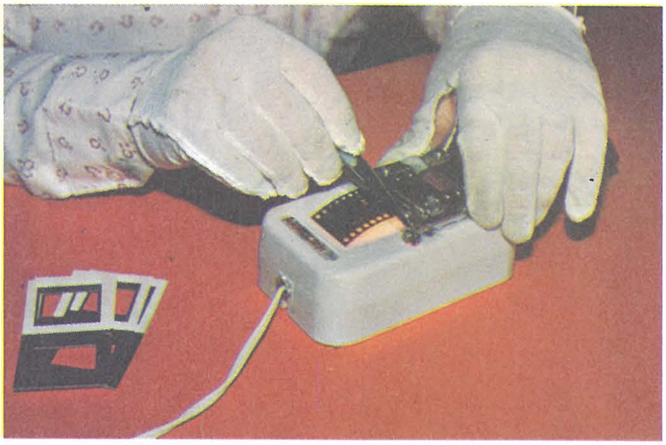
Taking the bad slides out of your show is easy. The tough part comes when you begin to remove the good ones. As one film editor told me, "That takes character." You have a dozen shots, all beautiful, of the same scene and you are proud of them—but when editing you must remember that your slide show is not a salon display of fine photography.

Naturally, you save all the shots you take out of your show. Use them in other slide shows; give them to friends; show them at the next camera club meeting.

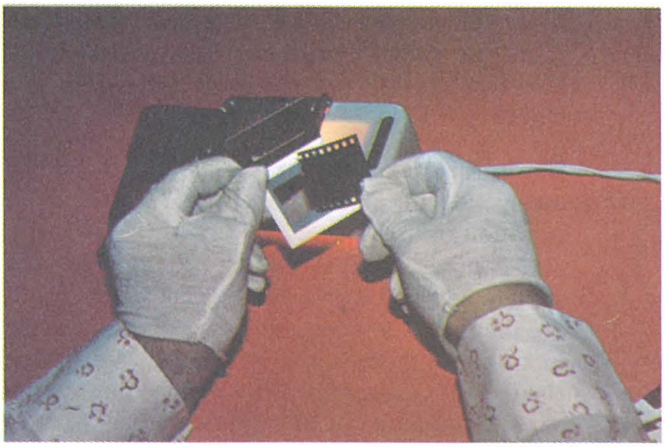
The second problem you run into while editing is the not-so-good shot which can't be left out of the show because it leaves a hole in the narrative. Everyone has pictures like this. Perhaps the camera was tilted or the subject is off to one side of the frame; or maybe you were too far away for the shot. Whatever the problem, you often can save pictures like this by cropping or reframing them.

To do this kind of work, you need a couple of pieces of equipment: a small press for mounting slides and a cutter for cutting individual pictures from a roll of film. You also need some empty slide frames. You can get all of these for an expenditure of less than $40.

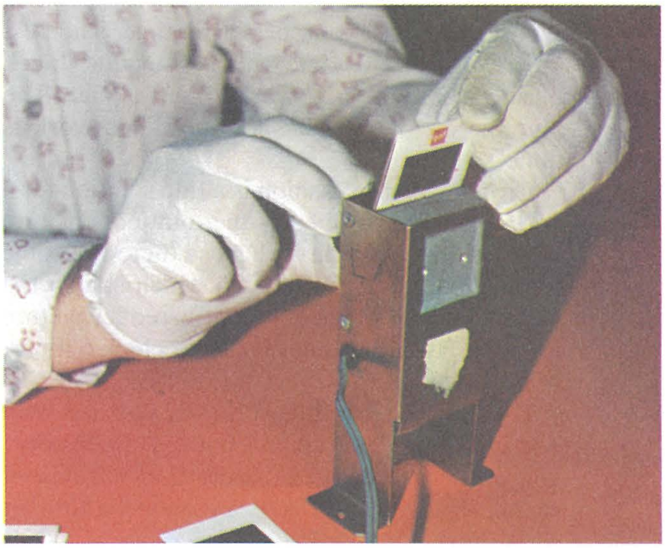
One word of advice before you start working with slides: Always wear editing gloves. Kodak and others make very inexpensive white gloves (a couple of bucks will buy half a dozen pairs) which you can purchase at all photo stores. You should use these gloves even when just sorting your slides; if you don't, you are sure to get fingerprints all over the film surfaces. These



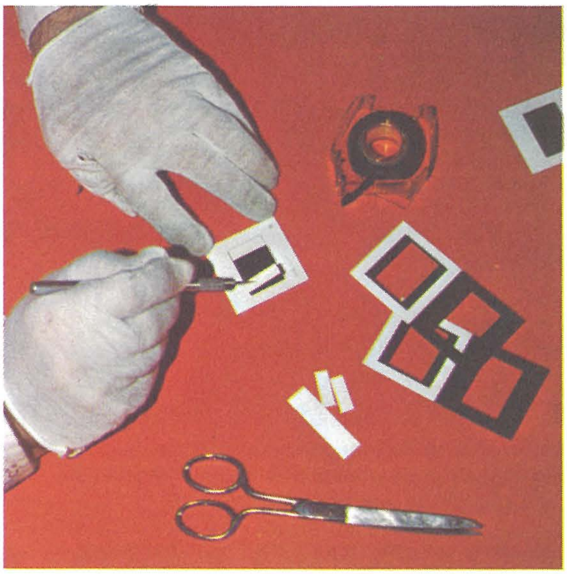
WHEN MOUNTING your slides, use white gloves to keep from fingerprinting the film. A cutter makes it easy to cut a roll of film into frames.



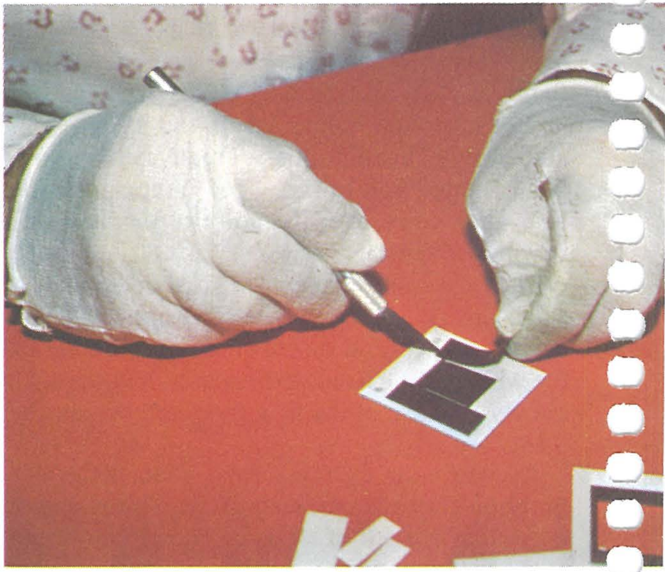
THE CUT PHOTO is placed in a new slide mount, the mount is folded over the film, and then the mount is sealed by heat and pressure.



THE SLIDE MOUNTER is a small unit which applies heat and pressure to the edges of a mount to seal in the film. Sealing a slide takes only a minute.



THE FIRST STEP in cropping a slide is to cut small cardboard pieces from an extra slide mount. The cardboard of the mount is the right thickness.



PLACE THE CARDBOARD pieces on the slide to crop out unwanted areas of the picture, then secure them in place with strips of opaque tape.

fingerprints are almost impossible to wipe off, and your skin oil will cause an eventual deterioration of the image.

Cropping. You shot a speeding boat and somehow it ended up way over on the left side of the picture. The boat and its wake make a fine picture, but there is a lot of empty water to the right. You can heighten the picture interest by simply cropping out the empty water.

For most cropping, you don't need to remove the film from the slide mount. You can cut small cardboard inserts from an extra slide mount, slip them into place on the slide being cropped, and secure them with a bit of plastic tape. The best tape to use is the kind which is opaque (black plastic electrical tape works fine for me). The pictures on this page show how this work is done.

Cropping in this fashion is a fine solution for a very common problem—the outdoor picture with too much sky in it. Unless there are some remarkable cloud formations which add to the picture interest, too much sky can reduce picture interest. Use a cardboard strip to block out part of the sky.

Using simple cardboard forms, you can crop one or both sides, top and bottom. Each time, you produce a projected picture of a different shape, which in itself adds a dimension to your slide show.

You can also cut special masks out of cardboard and insert them into your slides. By masking, you can make the shape of the projected picture different—oval, round, a double oval that looks like you are peering through binoculars at the picture, heart-shaped, etc.

To make such a mask, first cut a cardboard insert to fill the slide frame completely. Then draw the shape you want on the insert and use a sharp knife (Exacto, for example) to cut it out. Now place the mask over the film in the slide frame and tape it in place.

Once in a while, you can take a number of shots of the same subject and make an interesting display by cropping. If you have half a dozen shots of an approaching speed boat, for example,

WHEN CUTTING A PHOTO, use an extremely sharp knife or razor blade. Also use a steel rule as a guide to assure that the cut will be straight.

you can arrange these in sequence, with the first shot showing the boat some distance away and the final shot showing it close up. By cropping in tight on the first shot, so the projected picture is quite small, and then making each succeeding picture a little larger, you can enhance the feeling of the boat's approach.

Double and triple pictures. Suppose, in your show, you have shots of San Francisco's Trans-America Building and Chicago's John Hancock Building. You'd like to show them side by side for dramatic effect. You can do this by mounting both pictures in the same frame, making a double picture.

To begin with, of course, both shots must be tall and narrow so they'll fit in the same frame. Remove both pictures from their original mounts and then carefully plan where you will cut them. Remember that if you goof in the cutting, you will ruin the pictures. I lay the pictures over an empty slide mount, which enables me to see where the cut must be made and assures me that I have left enough film around the edges to fit into the mount.

When cutting the film, use a steel-edged ruler to guide your knife so you make a perfectly straight cut. Usually, you'll have to cut something from each side of each film to make them fit into the mount.

It is possible to mount the two pieces of cut film side by side in a new slide mount, but a far easier and better way is to purchase some metal slide binders and glass slide covers. These are standard photo shop items. The glass slide covers are very thin glass 2 x 2-in. in dimension. While you are buying these, also pick up a roll of very narrow black tape, the kind used by artists and persons making layouts for printers. Photo stores sometimes stock this tape, and all art supply stores have it.

Now lay the two pieces of cut film on one of the glass slides, positioned as you want them in the final picture. Place a strip of the thin tape between them to act as a divider of the picture. Lay a second glass slide cover over the first one, and insert the sandwich into a metal slide mount. If you have done the job right, you now have a double picture of your two buildings, divided by a thin black line. If you have cut your film with care and laid the black tape down correctly, no light will project around the edges of the pictures and you will have a very interesting comparative picture.

You can use the same technique to make three-part pictures, too. You can have pictures side by side, top and bottom, or cut diagonally. To be on the safe side, get some practice by cutting a couple of discarded slides first. Then carefully work on your better slides.

The final editing. When you have eliminated all the dull and duplicative slides, and cropped and remade those which could be improved, you are ready for the final editing of your show. Here there is one rule to follow: Keep the story moving. Each slide must give the viewer a sense of progress and of anticipation.

After you've shown an evening or two of slides, edited as we have described, you'll find people asking to see your shows—rather than suddenly remembering other engagements.

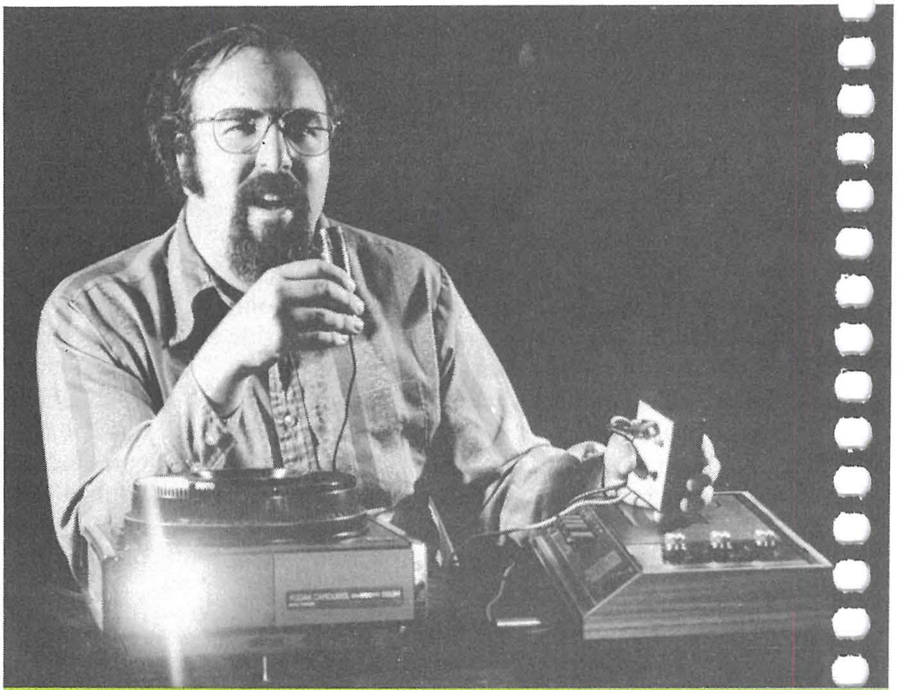
PLACE THE CUT film pieces on a glass slide, positioning them so they will show properly. Then use thin black tape to divide the pictures.

WITH THE FILM in place, put a second glass slide cover over the first, and insert the resulting sandwich into a metal slide binder.

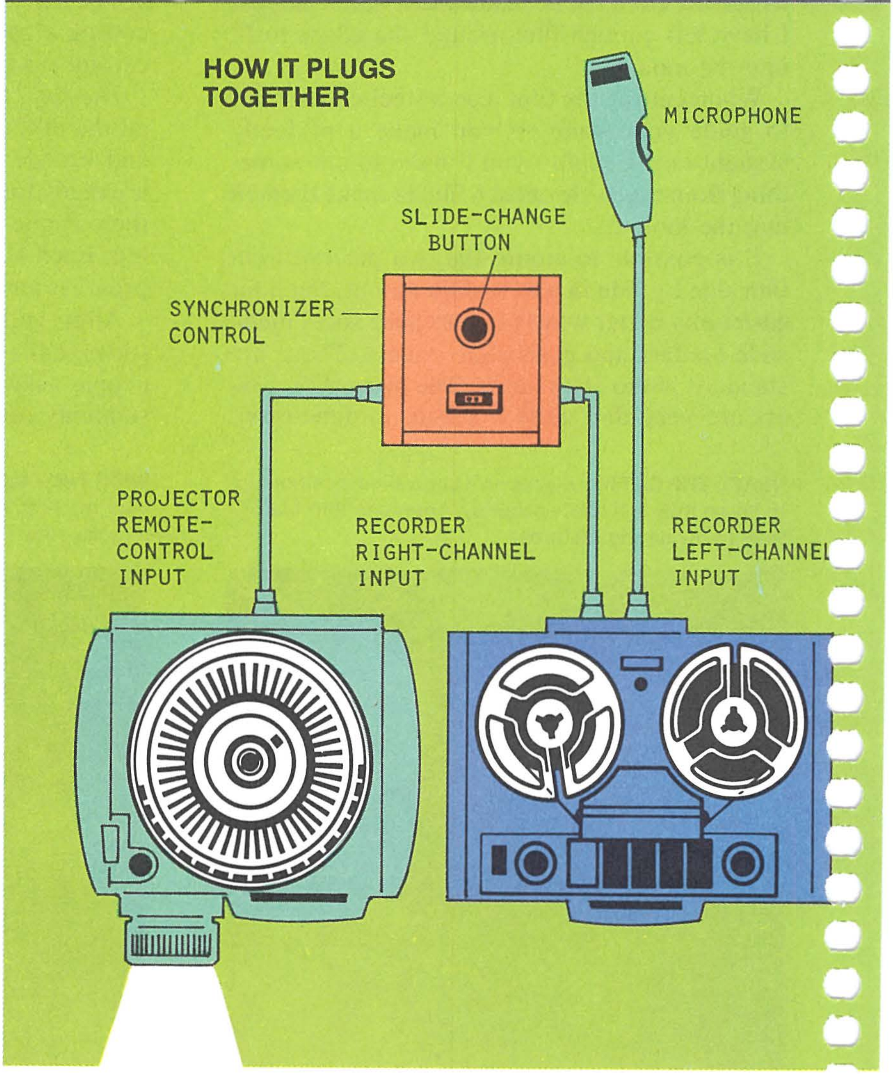
Liven up your slide shows with sound

No more fumbling with slides. Let your tape deck run your slide show, and you'll be free to relax with your guests while the tape gives your narration flawlessly

By BURT MURPHY



TAPING THE NARRATION for your slide shows is simple with today's synchronizers. First edit your slides and practice your narration. Then run through your show, narrating as you go. The pushbutton on the synchronizer (this one's from Edmund) simultaneously changes slides and puts a slide-change signal on tape. In playback, the slide-change signal passes through the synchronizer to trigger slide changes.


HOW IT PLUGS TOGETHER
MICROPHONE
SLIDE-CHANGE BUTTON
SYNCHRONIZER CONTROL
PROJECTOR REMOTE-CONTROL INPUT
RECORDER RIGHT-CHANNEL INPUT
RECORDER LEFT-CHANNEL INPUT

■ SOUND CAN DO almost as much for your slides as it does for movies. And most likely you already own most of the equipment you need to put your sound and slides together: a slide projector with remote-control slide-changing and a stereo tape recorder. The only extra you'll need is an inexpensive gadget called a slide synchronizer. With some synchronizers, you can even use a monophonic tape recorder.

With a synchronizer, you can put slide-changing signals on tape, together with commentary, sound effects and background music. Play it all back, and you can relax while the tape automatically changes your slides at precisely the right points in your narration.

You're not the only one who'll relax. Your audience will, too. They won't have to suffer through the missed slide changes, or the pauses while you try to remember whether this slide was shot at sundown or sunset, and whether that castle is in Disneyland or Bavaria. And the musical and other effects you can add make the whole show smoother and more professional.

how they connect to your recorder

Most synchronizers have two leads: One connects to your tape recorder, the other to your projector's remote-control socket. In recording, the synchronizer is connected to the tape deck's input, recording a beep each time you press the slide-change button; in playback, it's connected to the recorder's output and changes slides each time the tape plays the recorded beep.

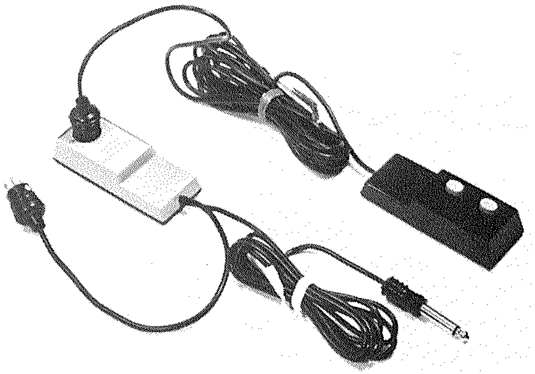
With a stereo open-reel recorder, you can record and edit the sound track till it's perfect, then add the slide-change signals. With a stereo cassette recorder, which usually doesn't let you record one channel at a time, you'll have to record both sound-track and slide-change signals simultaneously, which is a little trickier. Only the sound-track channel is fed to your speakers—you don't hear the beeps that trigger the slide changes.

There are several variations on this basic type. For example, while most synchronizers (such as the Airequipt) have their own slide-change buttons, Kodak's Carousel synchronizer has just a socket for the projector's own remote control unit. This lets you override the recorded slide-

SEE ALSO

Illuminators, slide-copy . . . Lightboxes . . .
Photo hints . . . Photography . . . Projector stands . . .
Tape recorders . . . Theaters, home

THIS ATTACHE CASE holds a complete slide show: A Kodak Pocket Carousel 200 projector and slide tray, an Edmund tape-slide synchronizer, a Sony Cassette recorder and all necessary cables. A stereo recorder would allow completely automatic operation; but for greater portability, a monophonic machine (like the one shown) can be used, and the slides can be changed manually when beeps are heard (refer to the text).

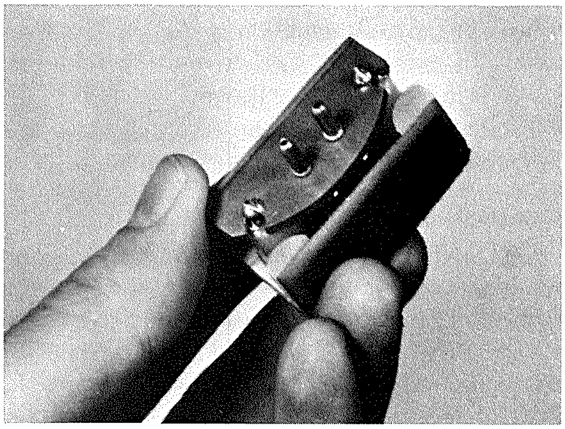


THE KODAK SYNCHRONIZER, unlike others, has no slide-changing buttons of its own. When making tapes, you advance the slides with the projector's own remote control cord, which plugs into the synchronizer. In playback, you can omit the remote cord—or use it to override the taped slide-change signals.

SAUNDERS SM-2 works with mono as well as stereo recorders. For recording, it has a built-in mixer to put the voice, recorded music and slide-change signals on the same tape track. For playback a speaker is built in, with bass response limited to frequencies above the 75-Hz slide-change signal, making it inaudible.

THE BELL & HOWELL Audio Cube (lower left) has a special, five-pin jack that simultaneously makes all connections with B&H's Filmosound recorder; there's no need to change connections when switching from recording to playback. Another, similar model is available for use with all conventional stereo recorders.

THE MESTON-MATIC fastens to the top plate of open-reel recorders, mono or stereo; then tape passes through the slot shown. You mount adhesive foil strips to the back of the tape to trigger slide changes (except on recorders which stop or reverse on foil-strip signals). But there's a shock hazard (see text).



change signals, skipping ahead or turning back at will. (If you're not planning to override the signals, you don't have to use the remote cord at all on playback.) One model of Bell & Howell's Audio Cube synchronizer comes with a special plug that simultaneously fits both record and playback outlets of B&H's Model 450 Filmosound recorders, so you don't have to change plugs when switching from recording to playback (the other has normal connections for standard stereo recorders). Edmund's Tape-Slide Synchronizer also has separate recorder input and output connections. And Honeywell's synchronizer fits compactly on the projector itself, with no trailing cords.

Synchronizers are available for monophonic tape recorders, too—but they're nowhere near as standardized in their design as synchronizers for stereo recorders are. And most of them are pretty expensive. The Saunders Mentor Mk IV SM-2 offers some interesting extra features for the money. Though it can be used with nearly any tape machine (including stereo recorders), it's specifically designed to overcome the problems involved when using monophonic portables, such as the small cassette machines so popular today. Because the speakers in such portables usually cut off when you plug anything into their earphone outlet (usually the only outlet on the machine), the Saunders has its own built-in speaker. Its trigger signal is 75 Hz—too low to be heard through either the Mentor's own speaker or through most speakers used with tape recorders, and low enough not to be annoying if it is heard. And to keep musical tones from accidentally triggering slide changes, the Saunders only triggers on pulses three-quarters of a second long. Because few monophonic recorders have built-in mixing facilities, the Saunders also has inputs for both microphone and the output from another tape recorder, with provision for monitoring the recorder's output through the

Saunders speaker. Cables are available to adapt the Saunders to Kodak Carousel, GAF and Sawyer projectors.

Kodak's Carousel Programmer Model 1 is about the same price as the Saunders, and has even more elaborate mixing facilities. But it's not really designed for cassette recorders, since it requires fairly good high-frequency response (its trigger tone is 6500 Hz, filtered out again in playback) and higher impedance than most transistor recorders can supply without an accessory transformer.

The Meston-Matic is far less expensive, and in a way, even more ingenious than the Saunders or Kodak units; but it's also the only one we found with a potential (if easily avoidable) shock hazard. The unit itself is a bracket with a slot and two switch contacts, designed to mount on the surface of an open-reel tape recorder, with the tape running through the slot. Then connect the Meston-Matic to your projector's remote-control socket and put a strip of adhesive foil on the back of the tape at every point where you want to trigger a slide change. The foil strip bridges the Meston-Matic's contacts, closing the slide-change circuit just as the projector's own remote switch would. Any open-reel recorder, mono or stereo, can be used, and the adhesive foil strips can be moved at will.

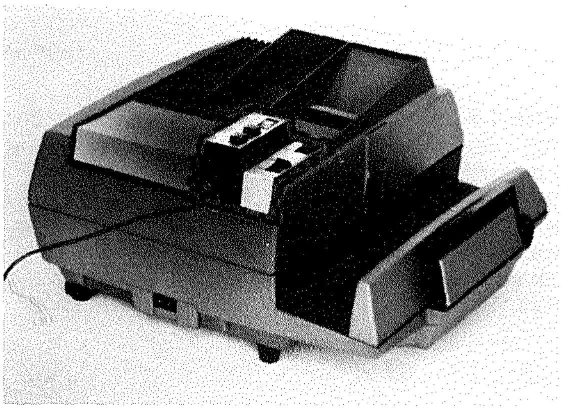
The potential hazard isn't in the synchronizer itself, but in its instructions. It's suggested that you cut your remote-control cord, install a regular a.c. plug on each cut end, connect a TV "cheater" cord with a.c. plug to the Meston-Matic's terminals, and connect all three plugs in parallel to a three-tap a.c. receptacle (not connected to your 117-volt a.c. power line, of course!). The danger is that someone may plug one of those normal-looking a.c. cords into a wall. Use any other kind of plug and the hazard vanishes.

But it takes thought, as well as equipment, to make a good slide-show. Be sure your slides are in logical order, and you know just what you want to say about each one. Rehearse a few times before taping, or, better yet, make practice tapes and listen to them objectively. For good, clear sound, don't hold your mike too close—8 inches to a foot is about right—and be sure your microphone isn't picking up the noise of the projector fan.

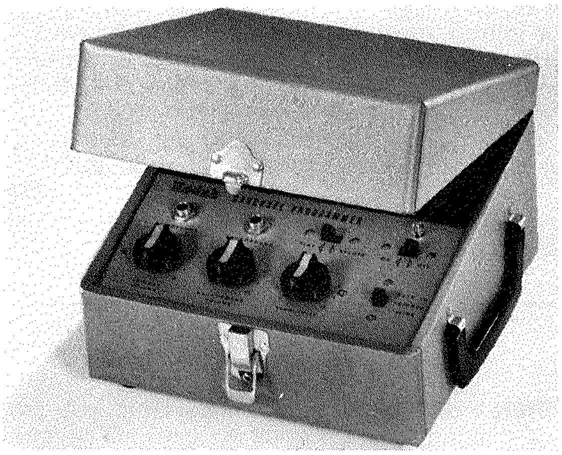
sources of information

As to the synchronizers themselves, for information on models for specific projectors, you can write to the following (or to the manufacturers of your own model): Airequipt, Inc., 20 Jones St., New Rochelle, NY 10802; Bell & Howell Consumer Products Div., 7235 North Linder Ave., Skokie, IL 60076; Eastman Kodak Co., 343 State St., Rochester, NY 14650; Honeywell, Box 1010, Littleton, CO 80120; and Saunders Associates (for Kodak and GAF projectors), Old Boston Rd., Wilton, CT 06897.

For information on universal synchronizers to fit all remote-control projectors, contact Edmund Scientific Co., 101 East Gloucester Pike, Barrington, NJ 08007, and Meston's Travels, Inc., 3801 North Piedras St., El Paso, TX 79930.

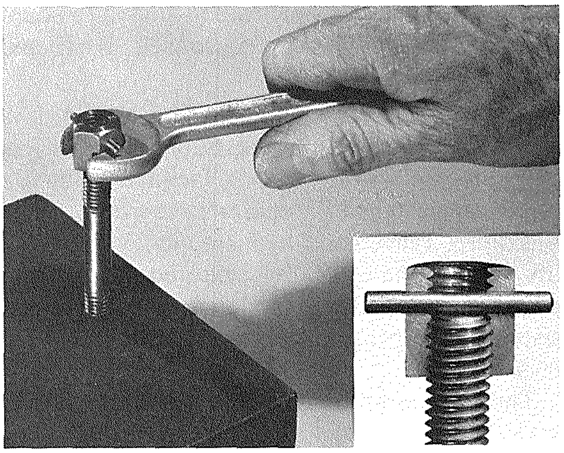


ON HONEYWELL remote-control projectors, the remote-control cord nestles in to double as the non-remote slide-change button. The Honeywell synchronizer (dotted line) replaces the remote cord either for remote slide-changing or as an on-projector slide-change control.

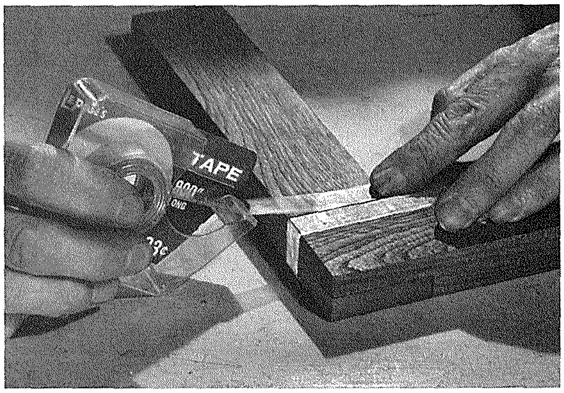


THE KODAK CAROUSEL PROGRAMMER, for monophonic tape recorders, incorporates a simple mixer to control relative voice and background-music levels. Its 6500-Hz trigger signal is stronger than most audio signals at that frequency, so musical tones won't trigger it. In playback the circuit that generated the tone filters it out again, so you don't hear it. A portable case is included. This unit requires 117-v.a.c. power.

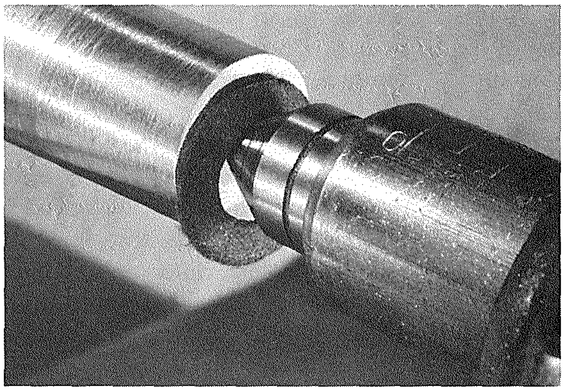
WHEN YOU FIND it necessary to drive a stud, but don't have the proper tools at hand, try improvising a driver from a matching nut. Drill a hole completely through the nut and drive a tapered pin into it. Be sure to leave enough room below the hole to allow for a good grip with the wrench. The pin stop will prevent the nut from jamming on the stud. To remove, just back the nut off the stud.



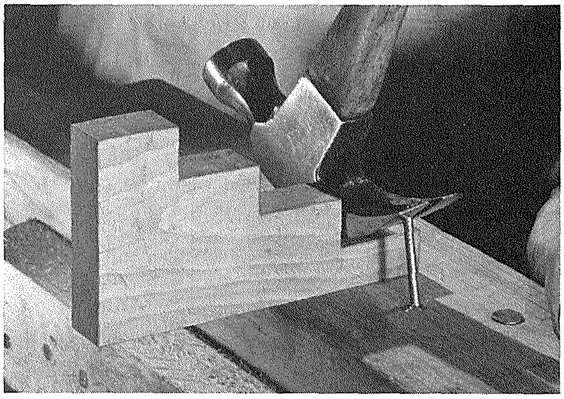
SOME GLUE is always squeezed out of a joint once clamping pressure is applied. To eliminate the job of scraping away this excess, mask both sides of the joint with cellulose tape. Lay the tape close to the edge of the joint and press it firmly to insure good contact. Once the glue hardens, pull off the tape and the glue will come with it. This is especially good when regluing finished joints which might be scratched during cleanup.

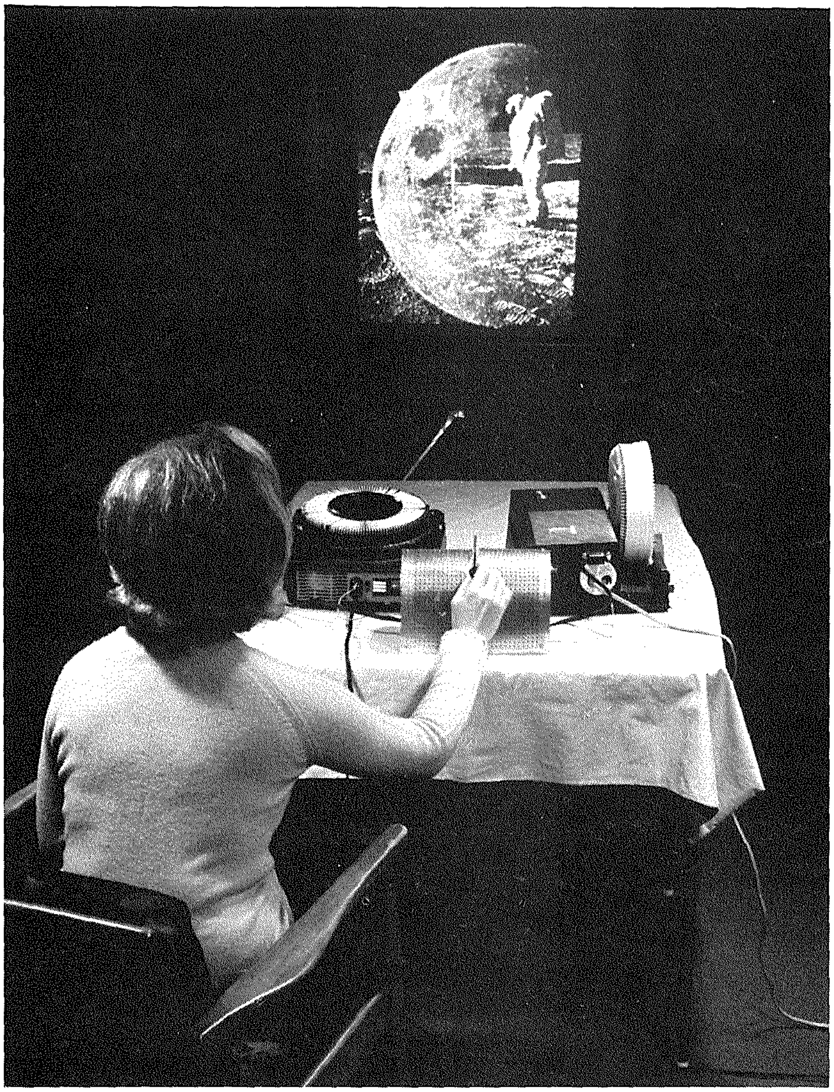


WHEN WORKING with your metal lathe, you can forget about the need to oil the tailstock center repeatedly if you slip an oil-saturated felt washer on the spindle before you clamp the work in the lathe. If the job is very large, it may be necessary to give the washer an occasional extra dose of oil. However, for the average job, the original oiling is sufficient. When not in use, store washers in a small bottle with enough oil to cover them.



USE OF THE STEP BLOCK shown at right is a big improvement over the usual practice of placing a scrap of wood under the hammerhead when pulling nails. As a nail is pulled, you can move the hammerhead up the steps for the best possible leverage. The block shown was cut with steps slightly less than 1 in. high. For stubborn jobs, make shallower steps. Another advantage of this block is that nails come out straight so they can easily be redriven if the job requires it.





Dissolve from slide to slide

By ROWLAND BURNS
and JAMES BLAIR

ONE SCREEN, but two projectors. You can dissolve from one slide to another without the intervening blank screen that almost always marks the amateur production.

■ ONE REASON professional slide shows are often easier to watch than amateur ones is that professionals dissolve their slides into one another. One slide fades in on the screen while the other fades out, with none of that abrupt black blink between pictures that accompanies slide changes at home. The pros have other uses for dissolves as well: time-lapse effects of changing seasons, fading sunsets, or a child's growth—even "zoom" effects from successions of slides showing the same subject at higher and higher magnifications.

Your home slide shows can have these professional effects, too. Though commercial dissolvers are expensive (over $200 for the Kodak model), here's one you can build for well under $20. And though its operation does require two remote-control projectors, most slide buffs have friends who would also be interested in such a project. The two projectors needn't be identical, provided focal length and accept bulbs of the same wattage.

The heart of the dissolver is a pair of standard room-light dimmer switches, with their knobs glued together (see photo, page 2807). A small hole is drilled along a diameter of the glued joint, and a rod inserted to act as a dimmer handle. Pushing the dimmer handle will fade one projector in while fading the other out; pulling the handle will reverse the action.

Plug the dimmer switches into the knob assembly, and mount the whole arrangement on a suitable base (say, 6 by 10-inch heavy plywood)

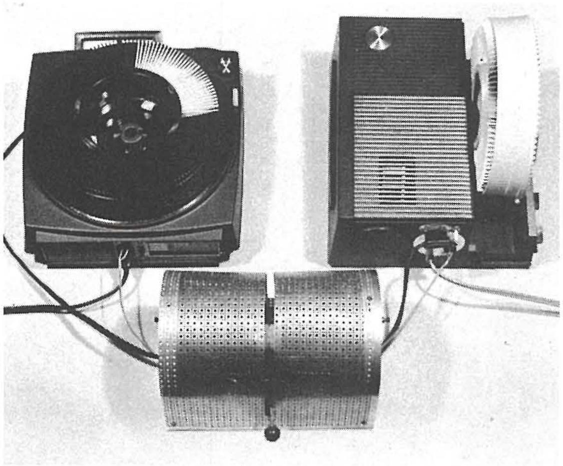
SEE ALSO

Illuminators, slide-copy . . . Lightboxes . . . Photography . . . Photo hints . . . Projector stands . . . Theaters, home

automatic dissolve, continued

with angle brackets. Make sure you can remove the dimmers readily to allow replacement should a dimmer fail, for easier balancing of the two projectors' light output, and (if your dimmers are the common push-on, push-off type) to allow the dimmers to be switched back on should they get switched off before or during assembly.

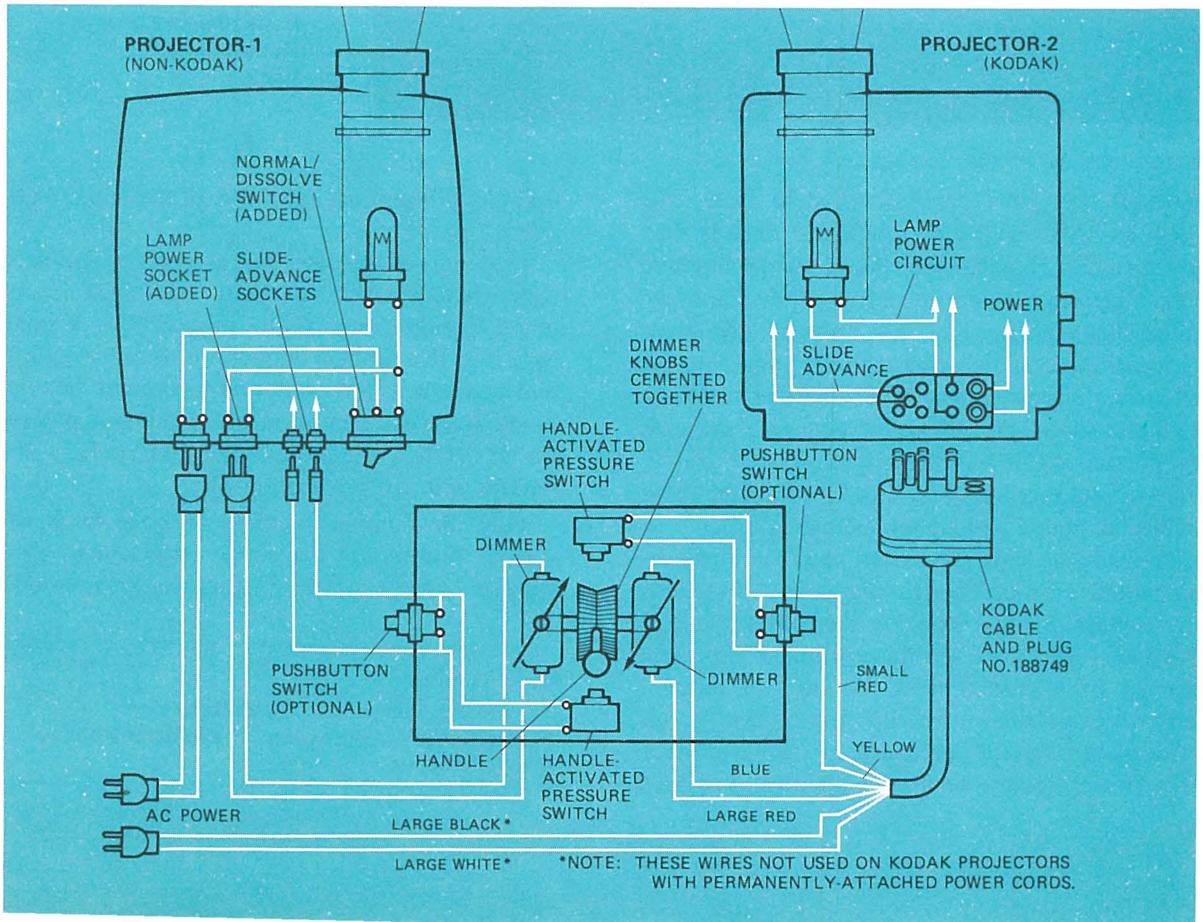
Mount roller-arm switches to the base so that the dimmer handle will press one switch closed at each end of its rotation; these switches will automatically change the slide in the darkened projector at the end of the dissolve. (Additional pushbuttons for manual slide advance may be wired in parallel with these switches, if you wish.) Now begin wiring the projectors.

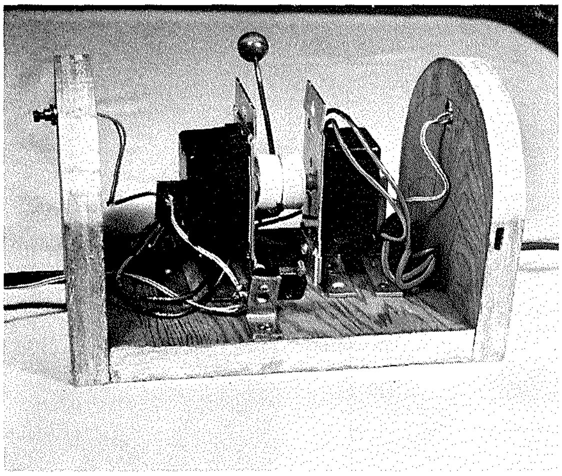


THE SIMPLE setup controls both projectors with one common lever. As shown above, there's no requirement that the two projectors be identical.

The dissolver operates by reducing the voltage fed to the projection lamps. But since fan motors cannot operate properly on this reduced voltage, some internal projector rewiring is called for (except on remote-control Kodak Carousel projectors, which have separate lamp connections in their remote-control sockets).

Wiring diagram for slide-dissolve control


PROJECTOR-1
(NON-KODAK)
NORMAL/ DISSOLVE SWITCH (ADDED)
LAMP POWER SOCKET (ADDED)
SLIDE-ADVANCE SOCKETS
PROJECTOR-2
(KODAK)
LAMP POWER CIRCUIT
POWER
SLIDE ADVANCE
DIMMER KNOBS CEMENTED TOGETHER
HANDLE-ACTIVATED PRESSURE SWITCH
PUSHBUTTON SWITCH (OPTIONAL)
DIMMER
KODAK CABLE AND PLUG NO.188749
SMALL RED
PUSHBUTTON SWITCH (OPTIONAL)
DIMMER
YELLOW
HANDLE
HANDLE-ACTIVATED PRESSURE SWITCH
BLUE
AC POWER
LARGE BLACK*
LARGE RED
LARGE WHITE*
*NOTE: THESE WIRES NOT USED ON KODAK PROJECTORS WITH PERMANENTLY-ATTACHED POWER CORDS.

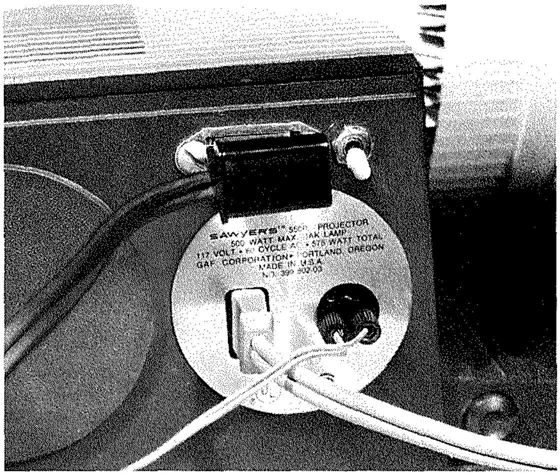


TWO ORDINARY light dimmers, their knobs cemented back-to-back, control the automatic cross fading. Note the control stick added to the knobs.

For non-Kodak projectors, find an area within the projector which is near the bulb and which has sufficient room for a 10-amp female socket (see photo above) and a 10-amp single-pole double-throw (s.p.d.t.) toggle switch. After building a pocket of masking tape inside the projector to catch filings, cut holes to mount the plug and switch. Then cut one of the two leads to the bulb, solder one of the cut ends to the switch's center terminal, and solder the other to one of the switch's remaining terminals and to one terminal of the newly installed female socket. Now connect the remaining terminals of the switch and socket to each other. (All wiring you add should be of at least as heavy a gauge as the original wire you cut, and should have insulation rated for a reasonably high temperature.) The switch position which reestablishes the connection between the bulb leads you cut earlier will allow for normal projector operation, while the other switch position is intended for use with the dissolver.

Connect one of the dimmers to an electric cord of the same gauge as the bulb wiring (insulation temperature rating matters less here), and connect to the cord's other end a male plug matching the female connector you installed in the projector. If you use standard a.c. plugs for this, it might be a good idea to paint the male plug a bright color, or otherwise indicate plainly that it is *not* to be plugged into an a.c. outlet.

If you've connected this projector to the left-hand dimmer, wire the roller-arm switch nearest you to the projector's remote slide-changing contacts. (These are the pins which will be shorted together when the projector's built-in slide advance button is pressed; if you're checking continuity with an ohmmeter, make sure the power is off first.) If you're connected to the right-hand dimmer, use the roller switch farthest from you.



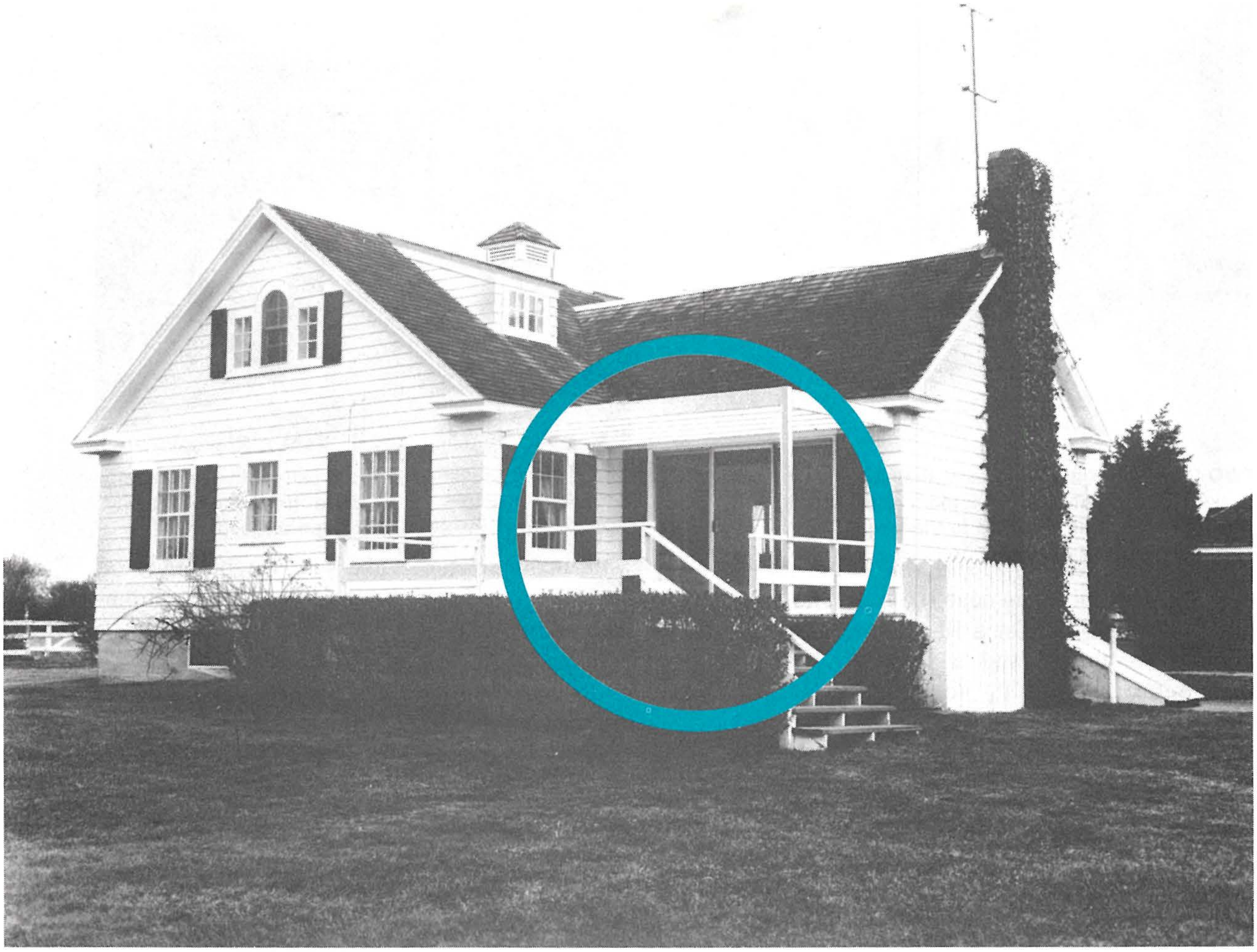
THE EXTRA socket and switch can be installed neatly on most projectors. Pin-plugs in the remote-control socket trigger the slide after each dissolve.

Kodak remote-control Carousel projectors require no modifications. Just have your dealer order a Kodak remote control cable and plug No. 188749 for you and wire it following the diagram on page 2806. On Kodak projectors with permanently attached power cords, such as the new Custom Carousels, the large black and white power wires at the squared-off end of the plug aren't used. These and any other unused wires should be taped back to avoid accidental contact with other parts. (For further information, write to Kodak's Motion Picture and Education Markets Div., Rochester NY 14650, for pamphlet No. S-54.)

If the screen illumination drops or peaks visibly during a dissolve (this is easiest to check with empty slide mounts in the projector apertures), you can minimize it by pulling one dimmer from the knob assembly and rotating it a few degrees before reattaching the knob, repeating this step through trial and error until light output is as uniform as possible.

Now cover the completed dimmer. Our case uses plywood end pieces and light aluminum filigree sheet, but materials and design aren't too critical.

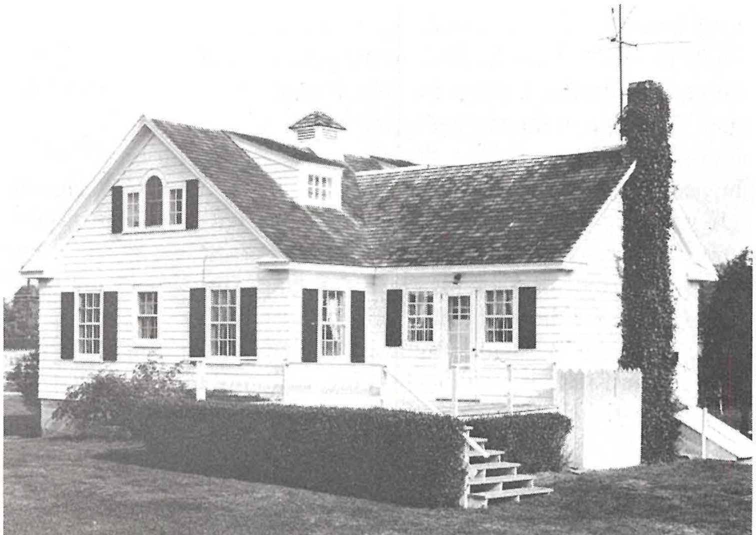
Remember when preparing slides for dual-projector shows that the slide sequence must be split between projectors, with all the odd-numbered slides in one tray and all the even ones in the other. And make sure you start your show with the odd-numbered slides (number 1, and so on) rather than with the even ones.



Let the outdoors in with sliding glass doors

By HARRY WICKS

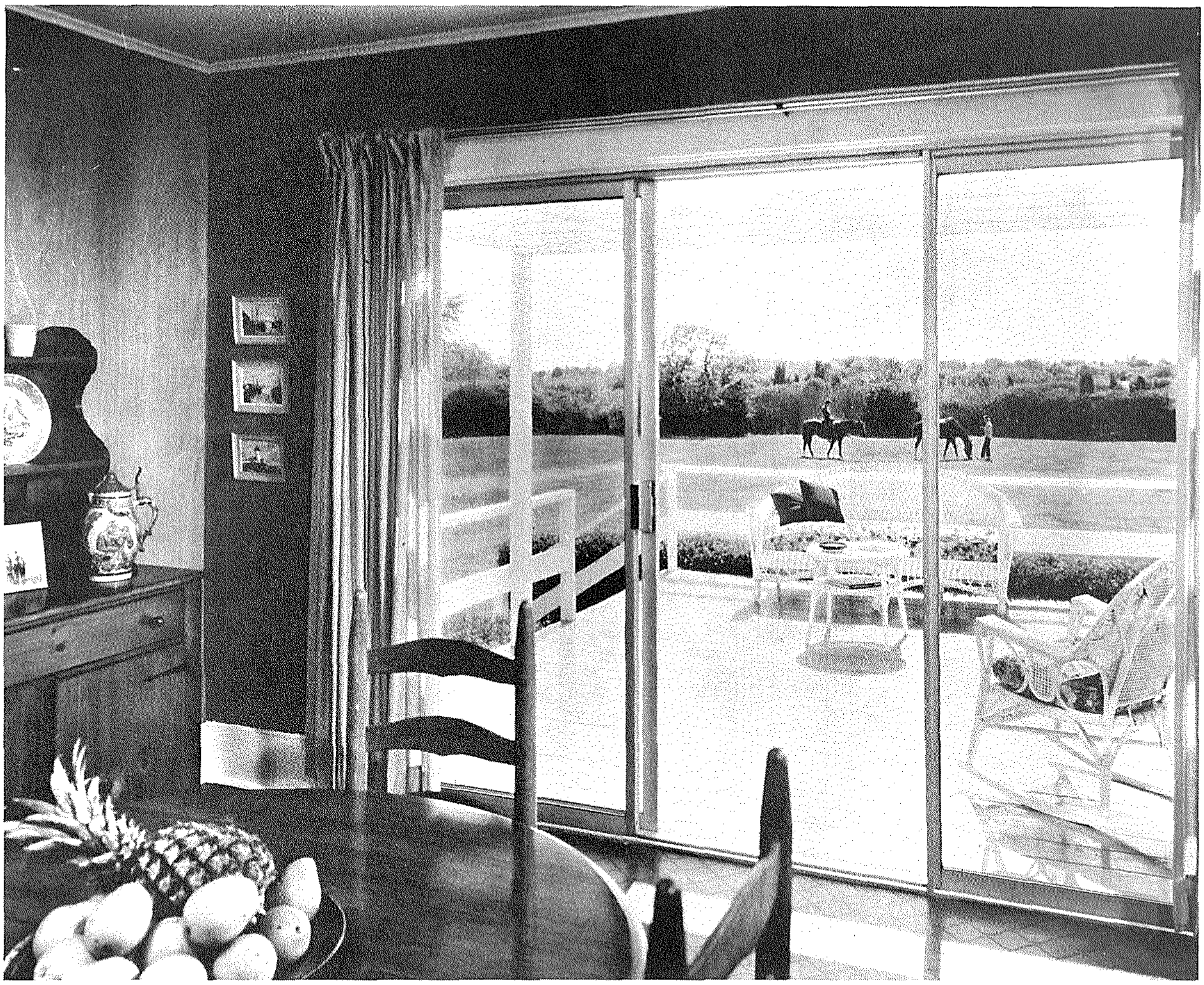
THIS WEEKEND HOME (below) began traditionally: a door flanked by double-hung windows. It looked pleasant, but see above and on the facing page how a transparent wall enhanced its livability inside and out.



If the view outside your home has visual appeal, sliding glass doors will bring it all inside

SEE ALSO

Doors . . . Locks, door . . . Patios . . . Remodeling, exterior . . . Storm doors and windows



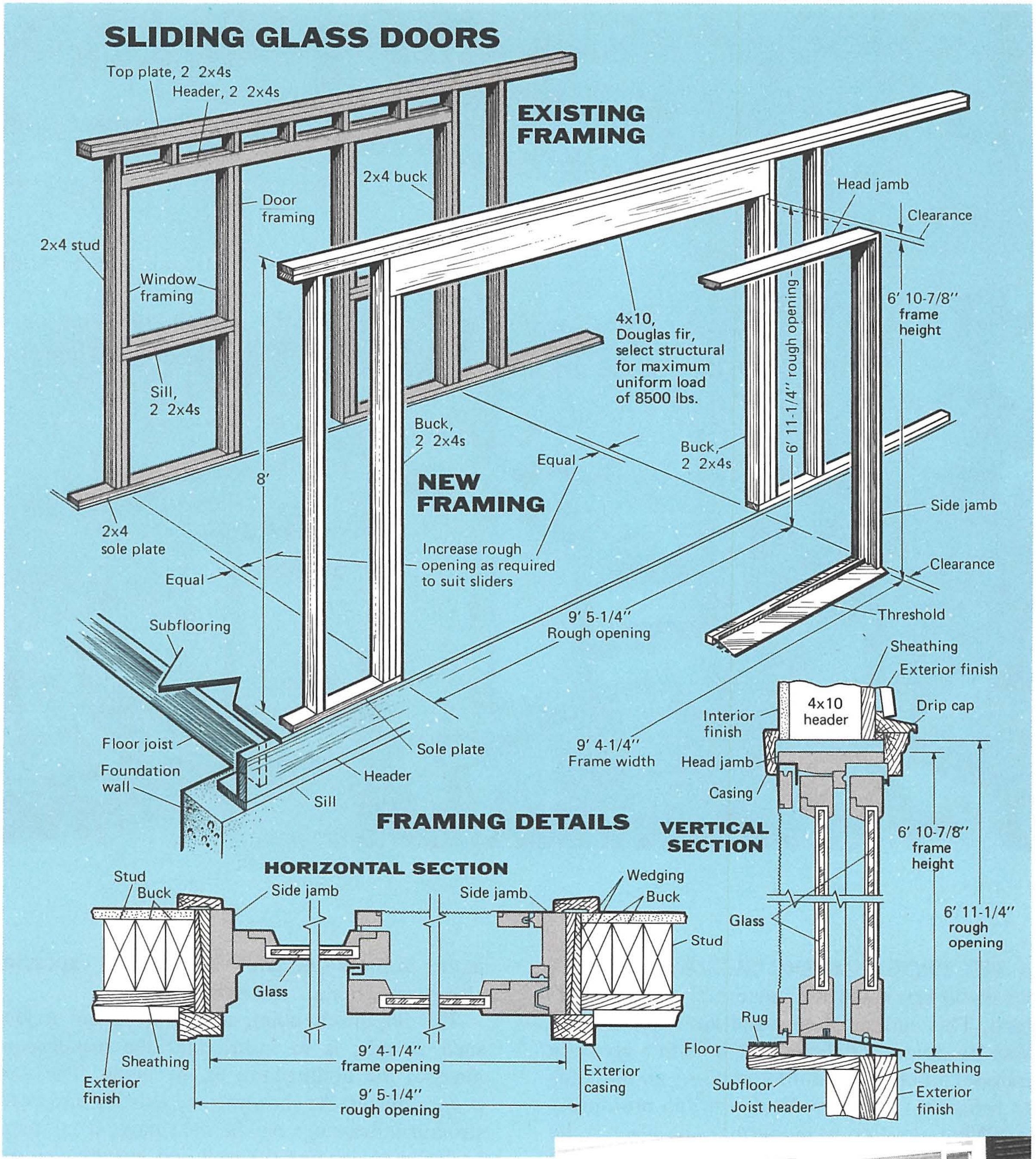
■ THE PROBLEM FOCUSED on an attractive weekend retreat at the eastern tip of Long Island. This summer home and vacation hideout was its owner's delight, but it didn't give the indoors much of the outdoor beauty so precious to refugees from New York's urban pressures.

"What can I do to modernize the place?" he asked. "What kind of change will let me enjoy it more?" Wayne Leckey, *Popular Mechanics'* Home and Shop Editor, offered a suggestion: Make a wall of the kitchen-dining area all-glass to let in the great view. The suggestion was an appealing one and the owner went to work.

The good-looking results, from both inside and out, are obvious in the photos on these pages. The front porch has been transformed from a simple walkway leading to the front door to a small patio for lounging. The sliding glass doors not only give a great view of the countryside but brighten up the kitchen-dining area by letting in more sunlight. The increased exposure also gives better air circulation.

The important point, when laying out a job such as this, is to insure that the installation matches the architecture of the home. The job is not difficult. As shown in the existing and new structural drawings on the next page, it consists basically of opening the wall and installing studs and header to suit the doors you buy. It pays to make an accurate scale drawing of the existing structure before you start. Then decide how big the sliding doors are that you wish to add. By laying out the new framing on tracing paper placed over the existing framing you will have an accurate picture of the raw materials you need.

Be sure the framing you install meets the minimum requirements of the Federal Housing Administration. If the area you intend to glass-in is longer than that shown here, be sure to check



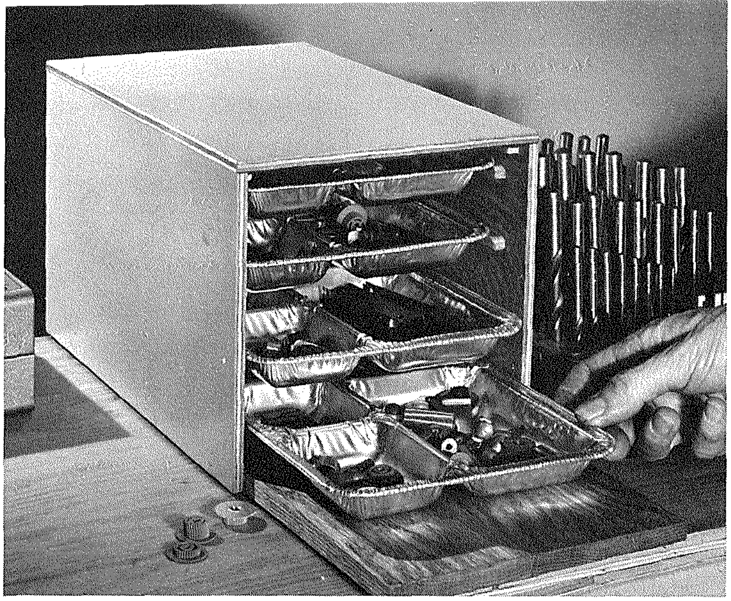
with the building department in your area to make certain that structural members meet the local code requirements.

When you are certain you have all the dimensions and materials correct, start by removing the existing framing. The new framing is constructed of 2 x 4s with the bucks on the end being doubled 2 x 4s for added strength. The top of the new framing is a 4 x 10 piece of Douglas fir. With the new framing in place, the door jamb is fitted into the opening and anchored securely.

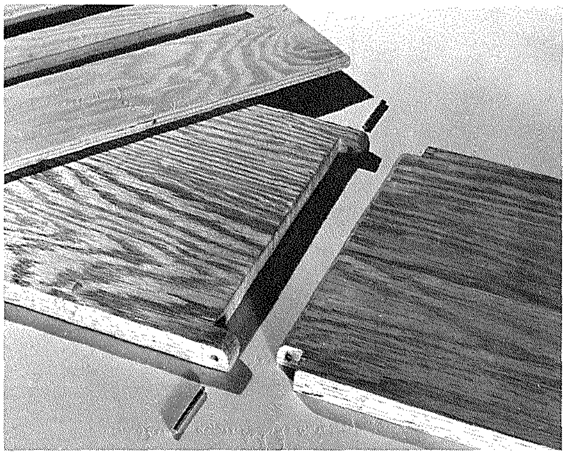
Small-parts drawers from TV trays

By WALTER E. BURTON

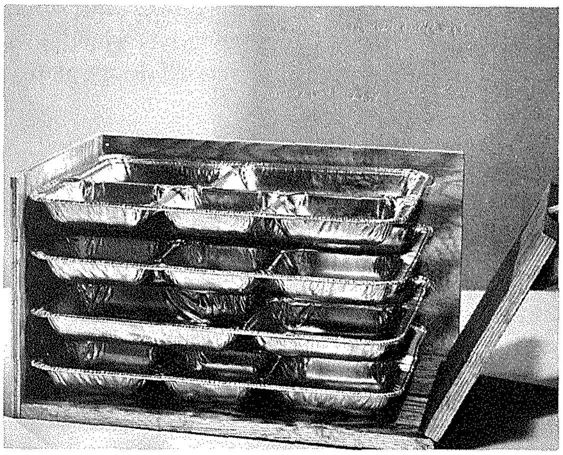
Made from some scrap wood and salvaged TV-dinner trays, this cabinet is a clever way to store small parts in your shop



PARTS-CABINET drawers are aluminum trays that were left over from four TV dinners. Compartments are adequate for small items.



PIVOT PINS, about 1¼ in. long, serve as hinges. Door is hinged first, then the sides are attached.



CABINET rests on four feet 3/16 in. thick and 1-in. square to give clearance for the door bottom edge.

CUTAWAY INSIDE view. Note that the door swings down flat, provides a surface for bottom tray to slide on.

■ USED AS DRAWERS in a parts cabinet, TV-dinner trays can be put to work to store anything small enough to go into their compartments. The "full-course" dinner trays are best because they are of sturdier construction than the small, individual serving sizes.

The four-drawer unit shown is built of ¼-in. plywood except for the door and bottom. The latter are of ½-in. oak, which just happened to be kicking around my shop. The lowest tray rests on the cabinet bottom, while those above slide in and out on 5/16-in. wood strips nailed and glued to the side panels. These strips are spaced so that there is clearance above each tray in case any of the contents project a bit upward.

SEE ALSO

Drawers . . . Storage ideas . . . Workbenches . . . Workshops

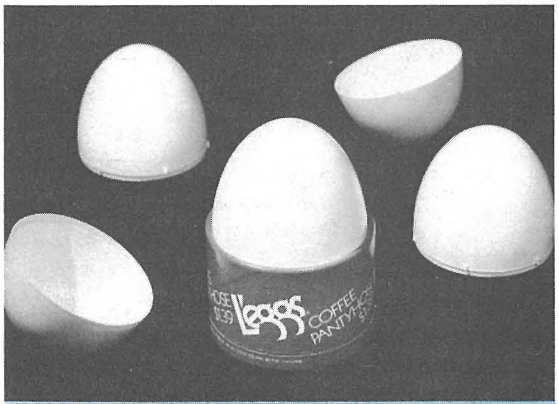
‘Eggs’ hold small parts

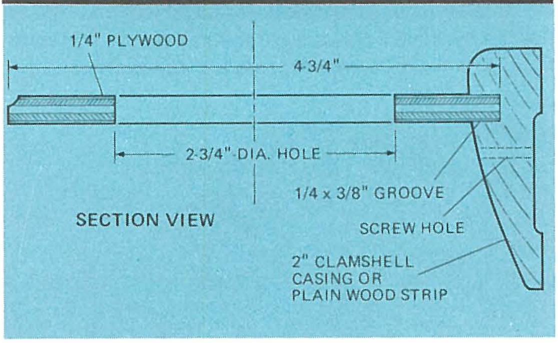
By **WYATT YOUSAY**

Here’s a workshop shelf to hold nuts, bolts and assorted odds and ends in the best possible containers (no kidding)—discarded panty-hose shells

MANY THROWAWAY containers have been put to use in the home and workshop to hold a variety of things. Baby-food jars have made great holders for screws, nails and the like. Modified bleach bottles have served a multitude of uses from grain scoops to paintbrush holders to funnels. Still another container which lends itself to holding things is the egg-shape one in which L’eggs panty hose are sold. It consists of a two-part white plastic shell. The half shells provide perfect little cups for brads, screws, nails, you name it, when supported by a shelf. Being conical in shape, they make it easy to pick out the very last brad, and the upper half of the shells can serve as covers.

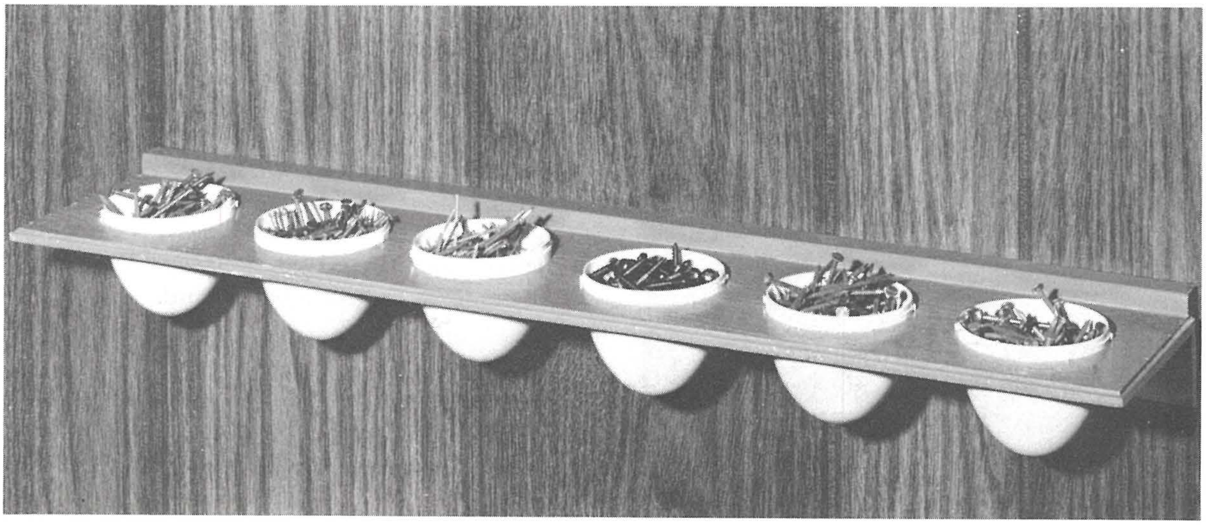
A row of holes 5 in. on centers is made in a scrap of plywood with a circle cutter chucked in a drill press; then the plywood is glued in a groove run in a scrap of clamshell door casing.





SEE ALSO

Fasteners . . . Shelves . . . Storage ideas



Skylight leaks—or does it?

I've installed combination skylights and vents in my attic and last winter they leaked, wetting the attic floor directly underneath. I've examined them and can find no place where water gets in. Yet it does, somewhere. There are louvers in the gable ends, but apparently these are not large enough, as the attic gets very hot in summer. Have you any suggestions?—H.O., Tenn.

If these skylights are of the "bubble" type and have been properly installed, they shouldn't leak. The wetness you're getting on the attic floor is probably condensate that forms on the underside of the lights and drips onto the floor. The moisture is condensed from the air in the attic. It does not leak in from outside. I hesitate to suggest closing the skylights with a tight-fitting insert, but this would seem to be the only preventive step. The disadvantage of this is that you may get condensate forming on exposed nails or plumbing vents.

To be effective, the inserts, or covers, must fit tightly to prevent warm air from the attic reaching the inside surface of the bubbles. You might try frames paneled in either glass or sheet plastic; the former sealed with putty, the latter with a mastic. If there is a door to the attic, be sure it is closed tightly in winter and also see that louvers in gable ends are open and that the screening is not clogged with paint, leaves or other debris.

Wood "putty" beads

I have to reputty my window sashes every two years or so; the new putty loosens and falls out. I use a standard glazier's putty that can be painted immediately after application, or so it says on the label. Isn't there some substitute for putty that won't loosen and drop out, at least within a reasonable time?—D.A., Ala.

Do you clean the sash rabbets thoroughly—both wood and glass—before applying? Are you sure the wood and glass are thoroughly dry before knifing in the putty? Do you press the new putty firmly in place to force it under the edge of the pane as well as to fill the rabbet? Only affirmative answers to these questions indicate that you are carrying out the necessary steps to assure adhesion of new putty in what I assume are old sashes.

A substitute for putty? Well, yes, you can rip triangular strips of white pine to the size of the putty bead and brad these in place, mitering the strips at the corners to form a neat, tight joint. The strips should be painted on the unexposed faces before application, and must be painted immediately after application.

Spindle scraper

I often clean old finishes off chairs having spindles or turnings. A flat scraper is not good for this purpose as it leaves ridges. Even scrapers with curved edges don't work well. Isn't there a better way or trick I don't know about?—R.E., Tenn.

Do you have an old pocketknife with a large blade that will hold an edge? Then grind a half-moon, or quarter-moon shape on the edge and hone it sharp. This is the best tool I've ever found for scraping the old finish off chair turnings or any small turnings. You can, of course, do this with any cabinet scraper, but the knife scraper is easier to manipulate and gets into the tight places. However, don't use this method on a valuable antique. Here, it's better to use a wash-off-type varnish remover. This will preserve the natural patina of age.

Insulating plank patcher

A room in my basement is finished with what I suppose are insulating planks of a soft, fibrous material. There are several unsightly digs and gouges. The color is off-white. What can I use as a filler?—L.G., Kans.

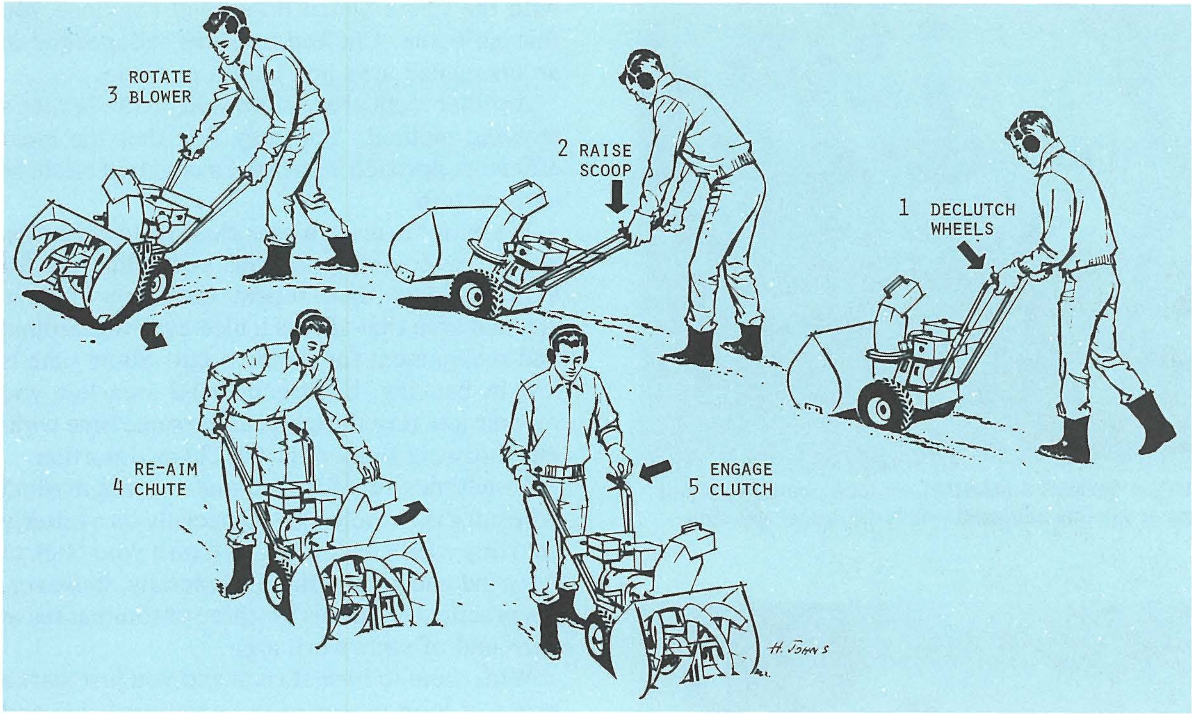
You might use a wood filler in powder form that's mixed with water—proportions are given on the container—provided the openings are small or no larger than a thumbprint. Press any extruding fibers back into the recess to be filled and then knife the mixed filler back in place, topping out the filler just slightly above the plank surface. Let the patch dry thoroughly, then sand it lightly until flush and finish with an off-white flat paint. It might help to add a transparent white glue, such as Elmer's, to insure patch adhesion.

Condensate on floor

The floor in my basement recreation room is tiled and walls are paneled. The poured-concrete foundation forms two walls of the room. The floor is drawing water along these walls. How do I stop this leak without taking up the tiles along the baseboard?—Robert Ash,Cleveland.

"Drawing water" is an unfortunate term—it does not describe what is happening. Water you see along the baseboard is condensate that will form on any surface at a lower temperature than the room air. Usually, improved ventilation is the cheapest cure; screen the basement windows and open them on cool days to let cooler, dryer air circulate freely. If there are no windows, use an automatic dehumidifier to lower moisture level of the air.

by W. Clyde Lammey



The right way to run a snowblower

THE TACTICS of farm or street plowing just don't work when you're clearing your property with a snowblower. You have to consider many more things.

First is the snow-removal area itself—a conventional walk, side drive close by the house, two-car garage ramp or a long, exposed drive are typical. Other factors are:

Type of surface. A smooth, hard surface is easiest; just set the blower height low. Crushed rock and gravel take a higher setting; rocks and pebbles thrown far and wide create a safety hazard.

Grades, slopes. A level-running speed may suddenly become too fast for a steep downgrade. A runaway snowblower pursued by a frantic householder isn't funny.

Targets to avoid. A neighbor's picture window, windshield, children and dogs are vulnerable to hard-flung stones or ice.

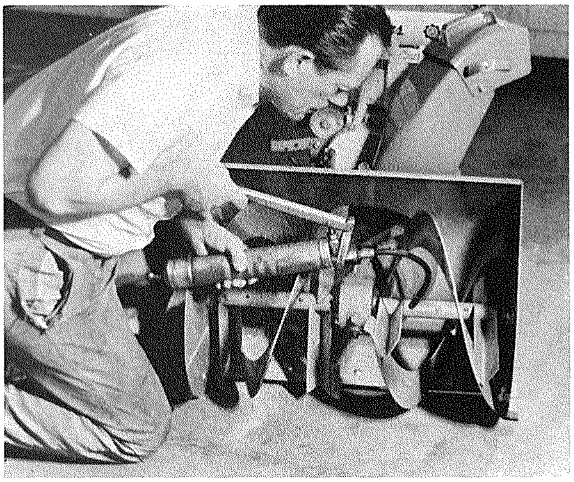
Property or machine damage. Stones along flowerbeds, buried survey stakes, shrubs, flowers and ditches should be cased and marked before starting. It's easy to tear up both blower and obstacle.

Wind direction. If you have a smooth, more-or-less even depth of snow, try starting the cut so the wind will cross your path at an angle, thus blowing snow to right or left. If a building is a factor, make a first cut close to it and cast the snow away.

Two mistakes often beset the beginner. First, he has seen television ads of blowers throwing snow 40 ft. or more, so he turns the chute discharge high. This rooster tail may be impressive, but it's seldom necessary or practical. Sooner or later it will lash back and leave you gasping. There's a chance that the blower will pick up something you didn't know was there and fling it into a target you don't want to hit.

The second mistake is assuming that unless the snow is thrown far away it will be handled a second time, doubling the work. A few trials

SEE ALSO
Asphalt driveways . . . Engines, small . . . Mowers . . . Snowplows . . . Tractor lifts . . . Tractor trailers . . . Yard machines



CHECK OWNER'S MANUAL for lube points. This unit was accidently delivered with a dry, auger gearbox.

PLASTIC PADDLES on lightweight blower are easily replaced. Be sure to check for the proper clearance.

with the chute aimed down will convince you this isn't true. Chewed-up snow redeposited in an uncleaned area just isn't a problem.

Another tactical error is based on the farmer's plowing method. You may feel that the most efficient approach is to make a constant circle or loop pattern.

It's better to make a pass close to your starting point, reverse the blower and back up for another pass; then repeat until you have a cleaned area that allows a nice easy turnaround and realignment for the next cut. Some time is lost in backing, but the cleaned area lets you reverse and turn the chute at the same time without throwing snow over the cleaned portion.

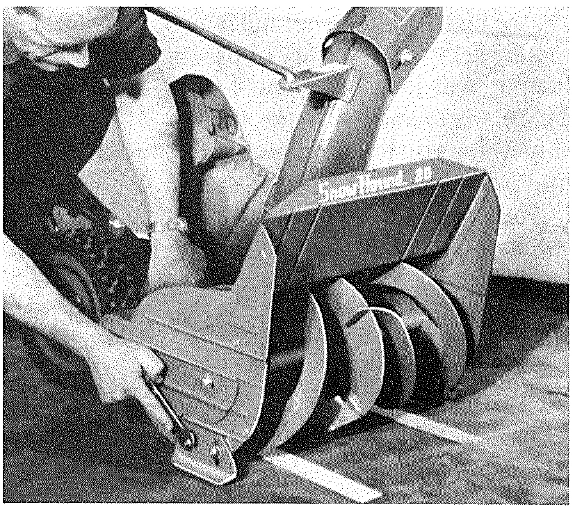
Sometimes this forward-and-reverse method is best for the whole job—especially on a bitterly cold day with a high wind. Just turn your back to the wind and keep it there. Generally, however, it's practical to do this for three or four passes at each end of your work area.

With room to turn at each end you just start a series of loop passes at the windward side and work towards the downwind finish point.

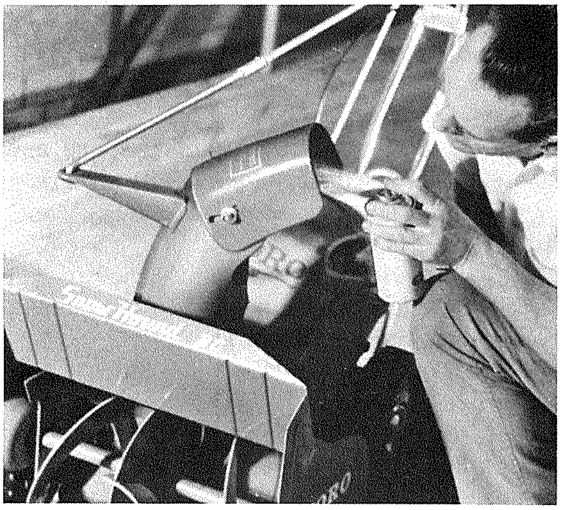
Learning how to turn a blower around properly takes practice. One good method is to declutch the hand clutch just as you come to the end of the loop. This disconnects the power from the drive wheels. At the same time, bear down on the hand grips and elevate the scoop a few inches so the auger doesn't start picking up snow until you're headed into your new pass.

Always turn so your body goes into any side or quartering wind. Turning the other way places

WOODEN SHIMS give adequate adjustment when the blower is to be used on a smooth, even surface.



SPRAY WAX applied to the inside of chute and discharge area will prevent snow from sticking to the metal.



the chute discharge between you and the wind.

On a straight walk or drive, usually you start to the windward and work to the lee with up-and-down passes. If working quarters are tight, such as a driveway between two houses, it is often practical to discharge the snow into a central windrow by working from both sides. This narrow heap of snow can then be cleaned up by starting at the garage and working toward the street with chute discharging straight ahead. A street plow throws it on your drive, so you might as well throw some back.

Hardened drifts, always tough to clear, are formed by heavy snow and howling winds. Often they are preceded by rain so that lower layers are soaked and well glued to the surface. When followed by below-zero weather, the drifts become almost solid and lower snow layers are rock hard. The usual snow blower doesn't have the weight and ripping power of a commercial plow to get under this type of drift. Instead, it rides up over the drift and trims a little off the top. A number of techniques can help:

- Remove the little skids on the snow scoop to get the sharp scoop edge down into the snow as much as possible.
- Place a sack of sand or salt on the scoop to hold it down.
- Put chains on blower drive wheels.
- As the auger bites into the hard, deep snow, declutch drive wheels so the blower can digest and clear the material. This lets all the engine power feed the blower and doesn't crowd the machine faster than it can work. By clutching and declutching with a rhythmic pattern, the blower will dig in and back off in a series of bucking actions, like the rocking of a stuck car.
- Break up the worst areas with a shovel jammed downward at intervals or use a small paddle-type blower to chop up the hard spots, then clear with the big machine. Amazingly, these lightweights will tear into snow the big augers can't touch. Small machines, gas or electric-powered, can be scooted all over like a vacuum cleaner or picked up in a two-hand grip like a shovel. They will clean steps and tough spots easily.

Regard the paddles as expendable. Made of a tough, durable plastic, they will take all sorts of arm-jarring beatings and come up smiling. Replace them after the season to be ready for next year.

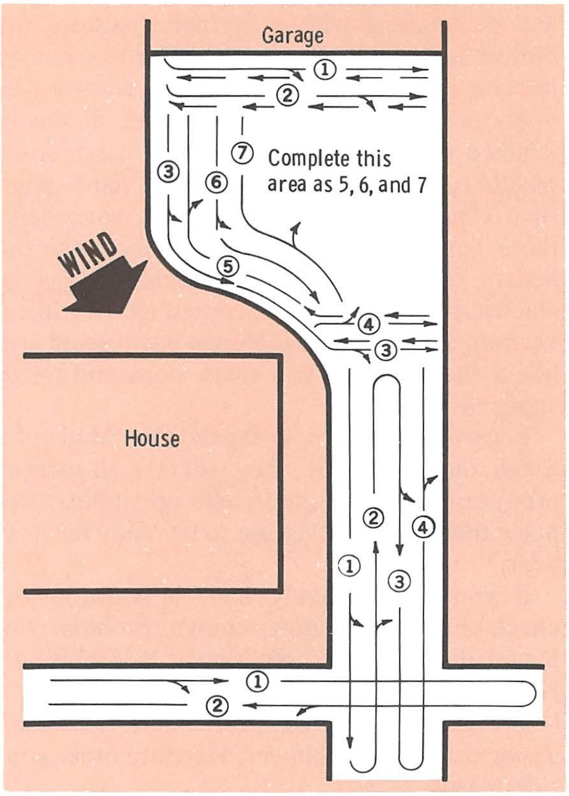
If you don't already have a snowblower, check the kind of snow-removal problem you have before you buy. No blower is ideal for all jobs. Often a small paddle-wheel type and a larger auger model may do the work faster and easier than a single blower. Here are other considerations:

Slopes and grades. Dragging a heavy blower back uphill is dangerous. If you have a slope, be sure to buy a machine with power reverse. If the area is small, a superlight job without reverse is good.

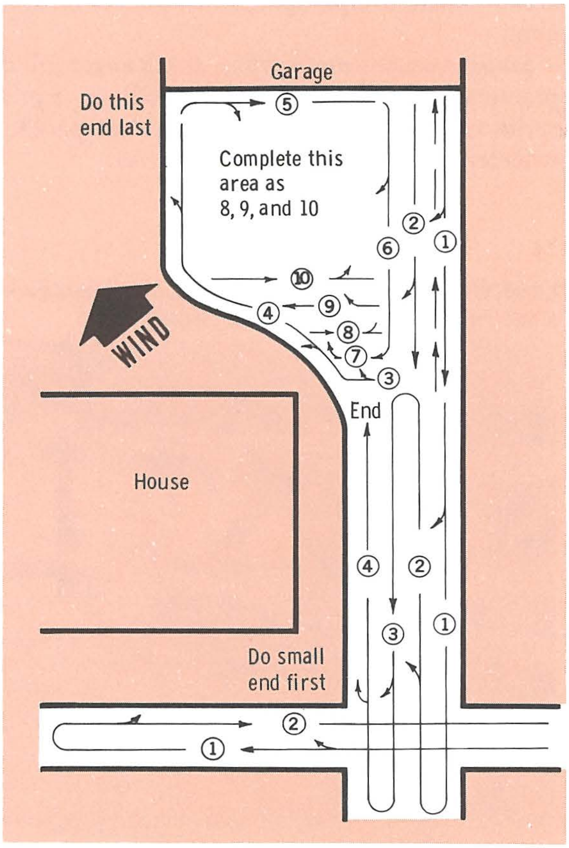
Steps, porches and patios. A big auger job is practically useless for cleaning small areas or a series of steps. A light gas or electric paddle-wheeler can be handled like a shovel.

LOW DISCHARGE is less dramatic than high rooster tail, but it is a more practical setting for the chute.

LIGHTWEIGHT paddle-type blower is best for steps and small areas. It can also break up large drifts.



WIND DIRECTION is one of the most important factors to consider when planning your attack. Here are two methods of handling a more-or-less typical layout that demonstrate how the pattern is varied to suit the wind.



Long runs. Clearing long drives and walks can get tedious, especially when snow cover is moderate, unless the blower has three or four forward speeds. A good one travels at a peppy walk. Fixed-speed types will merely prolong your exposure.

Storage. If you can wheel the blower into a garage or shed, size and weight are no problem. If you'll store it in a basement or elevated porch, think light.

Special uses. Maybe you want to take your blower to a hunting cabin or carry it in your car's trunk in case you get stuck.

Snowblower design and construction is not quite so standardized as that of automobiles. With a new blower, give yourself an hour of unhurried study to read the instructions and examine the guts of your machine. Search out the lubrication points, and if you don't have the grease guns, oil cans and lubricants, spend a bit to set up for quick servicing during the heavy-use season. Time spent now and an occasional lubrication and chain and belt adjustment will save hours of future trouble.

Before you take your new blower out for a trial spin, keep these points in mind:

Panic stop. Know the quickest and safest way to cut the engine in case you should run into an unexpected obstacle.

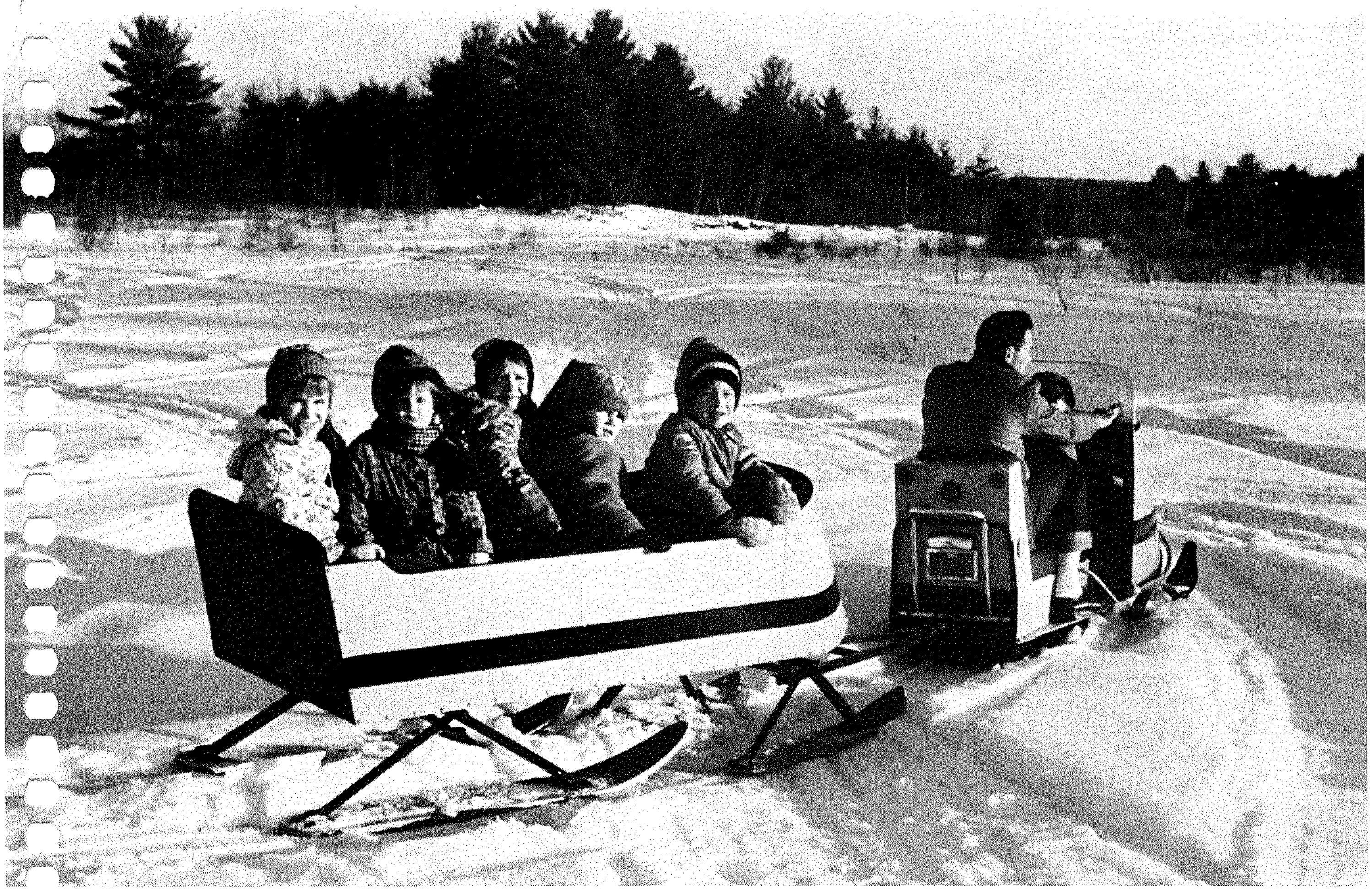
Blower declutch. With a dog-clutch drive to the blower you can tear things up by trying to engage a dead blower shaft with a spinning, main-drive shaft. Your instructions will give the proper sequence. You can also play hob with your blower by driving it into a garage or storage shed with the auger spinning.

Fuel shutoff. Some engines have none; others have a manual shutoff valve and a few have carburetor drains that dump a trickle of gas when stopping. Leaking gas in a closed, heated garage can spell danger. If you have a gas valve, get in the habit of closing it.

When spring finally arrives, take an hour or so to prepare your snow blower for summer:

- Get rid of all old gas in tank and carburetor. Run it dry, if necessary.
- Drain the oil; replace it with fresh.
- Grease and oil all bearings, chains.
- Replace the vee belts if they look worn.
- Replace the sparkplug.
- Oil the control linkages and Bowden wire cables.

Finally, if it was a hard season, have your repair agency look over the clutch and drive train before next fall's rush.



Build a sleigh for your snowmobile

By HANK CLARK

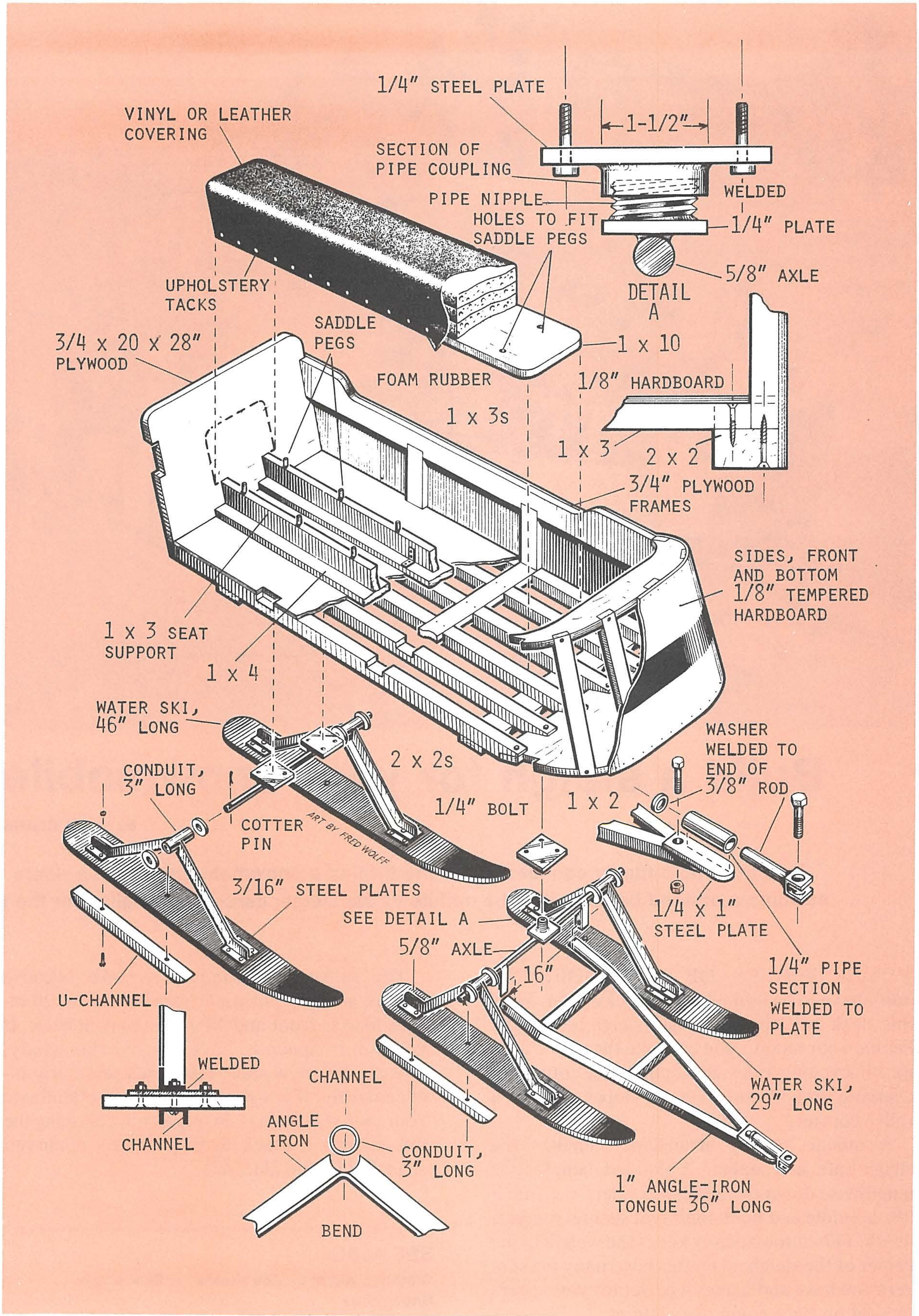
Now the whole family can join you in the thrill of a snowmobile ride. Five riders straddle a padded bench down the middle of the sleigh, centering weight over the runners

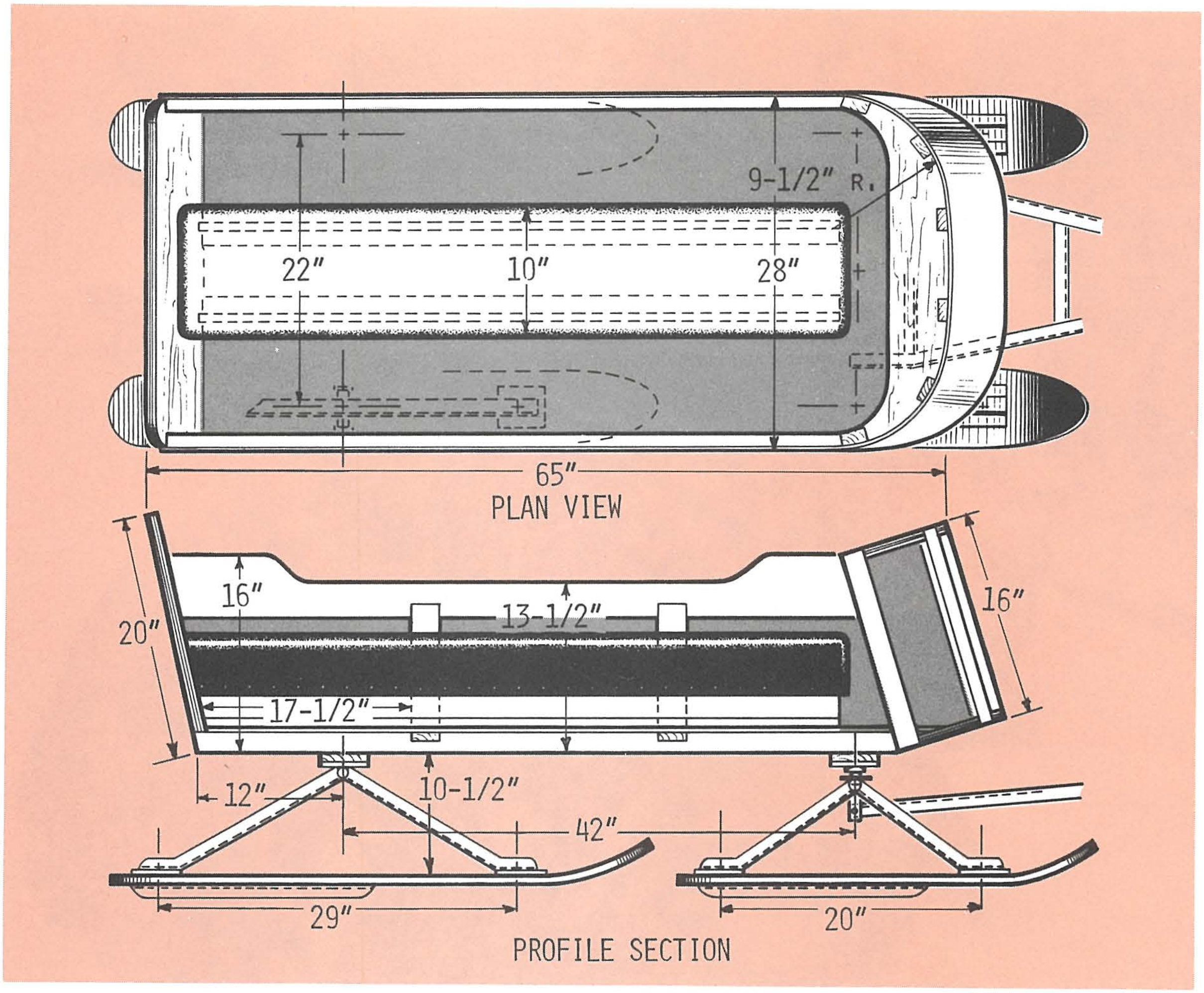
▨ THE THRILLS OF SNOWMOBILING don't have to be limited to one lucky rider. With this sleek little five-passenger sleigh hooked on behind your mount, you can take the whole family on exciting rides through the countryside, charging up and down snowy slopes as if on a roller coaster.

A unique seating arrangement makes the sleigh safe and stable. A padded bench runs lengthwise down the middle so riders straddle it like a saddle and hook their feet securely underneath. This automatically keeps the weight in the center of the sleigh no matter how many passengers you have and makes it easier for youngsters to hold on tight going over bumps.

The runners are simple to make because they're actually old water skis cut down, 29 inches long in front and 46 inches long in back. If you don't happen to have any old skis handy, you can buy new short children's skis fairly inexpensively. If you prefer, you can also laminate your own skis from ¼-in. plywood, clamping the tips against a block to provide the upcurved shape while the glue sets.

SEE ALSO
Clothing, winter . . . Ice skates . . . Skis, snow . . . Snowshoes


1/4" STEEL PLATE
VINYL OR LEATHER COVERING
1-1/2"
SECTION OF PIPE COUPLING
WELDED
PIPE NIPPLE
HOLES TO FIT SADDLE PEGS
1/4" PLATE
5/8" AXLE
DETAIL A
UPHOLSTERY TACKS
SADDLE PEGS
3/4 x 20 x 28" PLYWOOD
1 x 10
FOAM RUBBER
1/8" HARDBOARD
1 x 3s
1 x 3
2 x 2
3/4" PLYWOOD FRAMES
SIDES, FRONT AND BOTTOM 1/8" TEMPERED HARDBOARD
1 x 3 SEAT SUPPORT
1 x 4
WATER SKI, 46" LONG
2 x 2s
WASHER WELDED TO END OF 3/8" ROD
CONDUIT, 3" LONG
1/4" BOLT
1 x 2
COTTER PIN
ART BY FRED WOLFF
3/16" STEEL PLATES
1/4 x 1" STEEL PLATE
SEE DETAIL A
5/8" AXLE
16"
1/4" PIPE SECTION WELDED TO PLATE
U-CHANNEL
WELDED
CHANNEL
WATER SKI, 29" LONG
CHANNEL
ANGLE IRON
CONDUIT, 3" LONG
1" ANGLE-IRON TONGUE 36" LONG
BEND



The runners are arranged so they pivot independently, allowing them to follow dips and rises smoothly. Short lengths of steel or aluminum channel are screwed to the undersides of the skis to give them a grip in the snow and keep them from sliding sideways. The runners are held to the sleigh body with angle-iron struts. These are bent and welded to axle bushings as shown in the drawing.

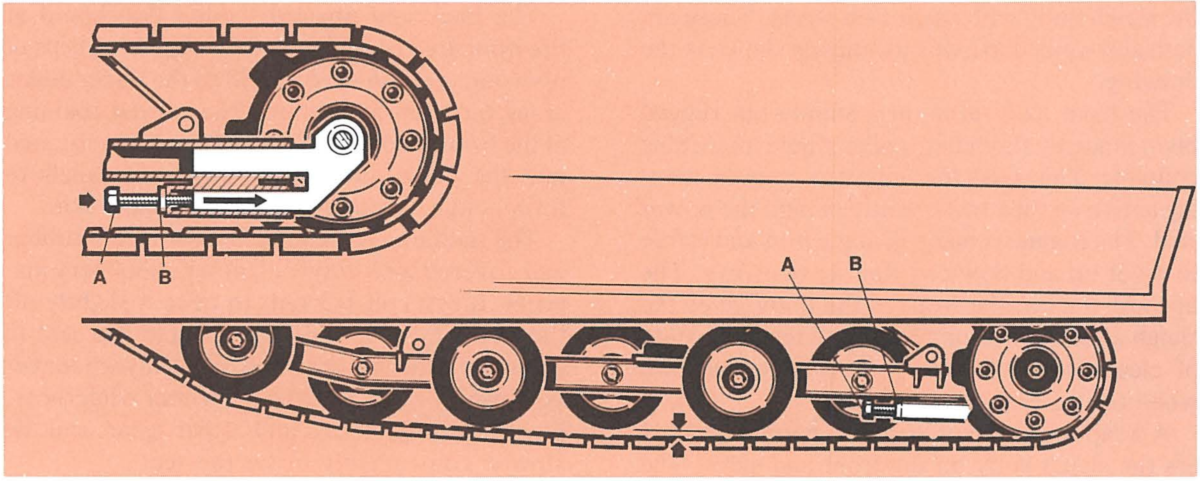
The front axle turns on a simple but rugged pivot made by threading a pipe nipple into a pipe coupling. This gives the runners a smooth steering action so they track neatly behind the power sled. The tongue is made of angle iron and is free to pivot up and down as well as sideways. The upward slant at the front of the body gives the sleigh a racy appearance and also insures plenty of clearance for the tongue to swing upward when the rig noses into a gully.

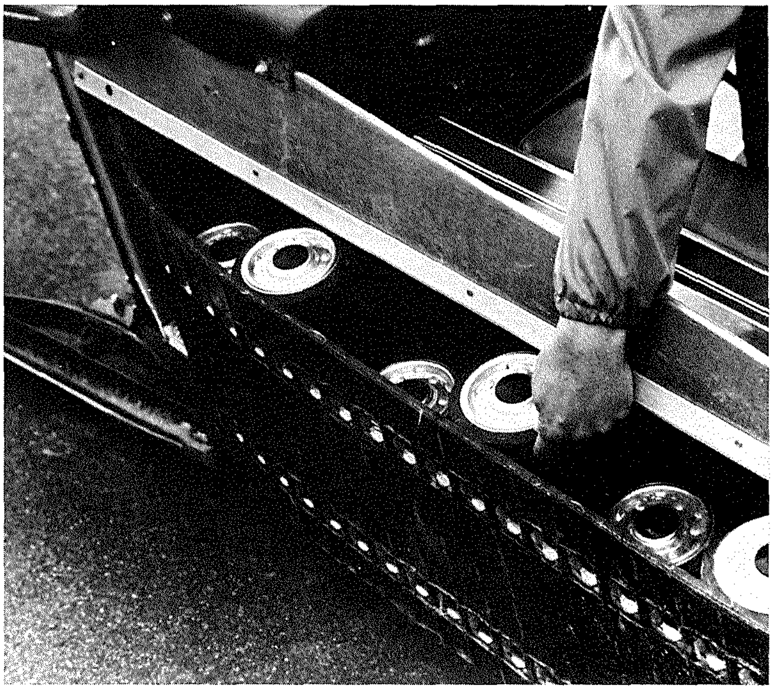
A wrap-around skin of ⅛-in. hardboard covers the sleigh body on the front and sides. The floor consists of 2x2s also covered with hardboard, making a sturdy but lightweight platform. Tempered hardboard is strongest and best for the flat areas, but the untempered type is easier to bend and may be handier to use for the curved cowl in front.

The back and upward-slanted floorboard at the front are ¾-in. plywood for rigidity. Strips of plywood are also used to stiffen the upper edges along the sides and to form the curved coaming at the front. Cross strips of 1x3 stock are notched into the floor rails and the plywood panels to form a sturdy frame for the hardboard skin.

The saddle seat is cushioned with foam rubber and covered with vinyl or leather upholstery material. It rests on 1x3 rails to raise it slightly off the floor. Pegs set in the rails hold the seat in place but allow it to be lifted out easily whenever you want. For safaris into the winter wilderness, picnic snacks, tools and other gear can be stowed conveniently under the seat.

EVERY SNOWMOBILE has a means of aligning the track. This one has a track-adjusting screw (A) which is held by a locknut.





CHECK SKI alignment by measuring the distances between the skis at both their heels and toes. They should be equal. To check for bad bogie bearings (right), spin each wheel by hand and listen for a vibration noise.

Get your snowmobile ready for snow

By HENRY B. NOTROM

You promised you'd get to your snowmobile before next season. With the first snowfall you'll want the machine in a hurry. Here's a quick home checkout for your hardworking snowmobile before you take it out for the winter season

▪ MAINTENANCE CHECKS you can make to get your snowmobile in top condition would cost a lot if done by a professional mechanic. Here they are:

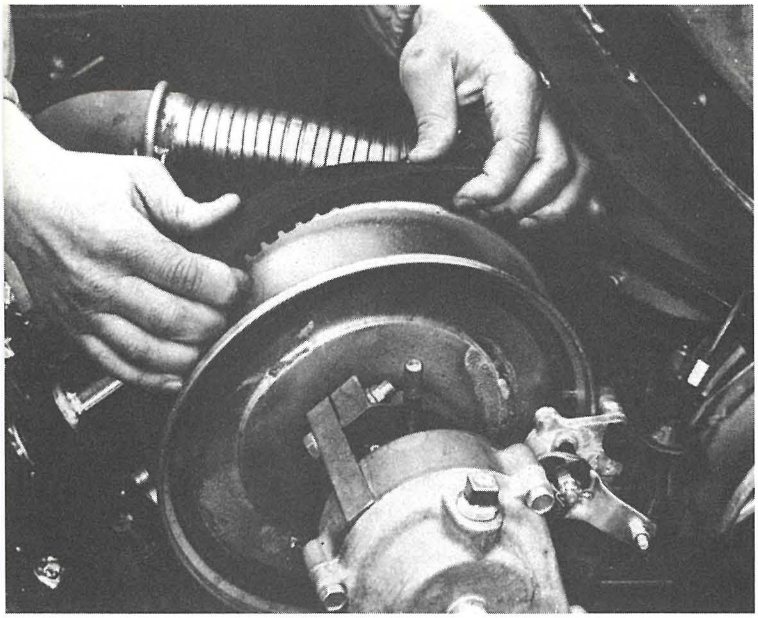
- *Service suspension and adjust track.* Some makers recommend that bogie wheels be removed for special treatment. If this was not done when you stored the machine, do it now. The procedure is simple: To remove bogies from a SkiDoo, for example, take off capscrews and star washers that hold the cross shaft to the frame and slide wheels off the frame. Wheels come off in sets.
- *Remove cross shaft from each set and check to see it's not bent or worn.* Clean dirt off all parts and apply a metal protector to bogie wheel springs. Coat each cross shaft with a thin layer of low-temperature grease.

No matter what make machine you own, raise and support the rear of the vehicle, release tension on the track and spin each bogie wheel to check for seized bearings. If a wheel "clatters" or binds, have the entire system checked.

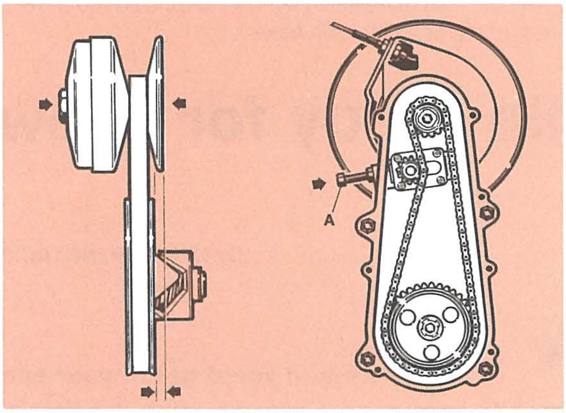
- *Check and adjust track tension.* This is done differently, according to make and model. Yamaha and Evinrude tracks must be raised so they don't support the machine. But Mercury

SEE ALSO

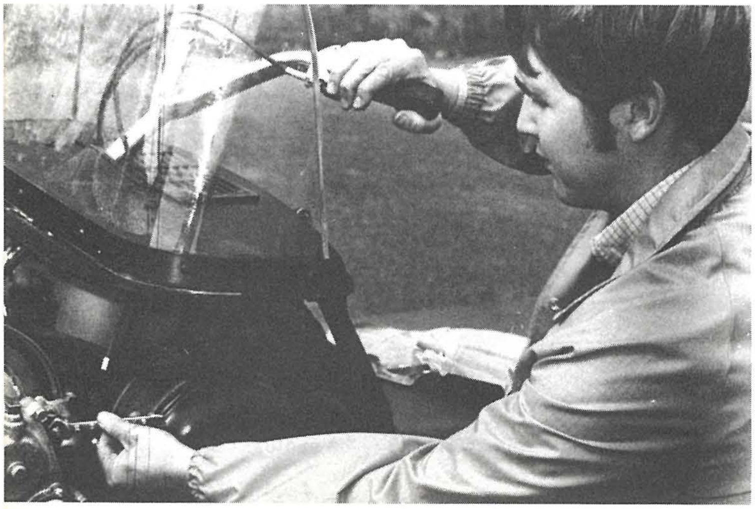
Clothing, winter . . . Engines, small . . . Ice skates . . . Skis, snow . . . Snowshoes



DRIVE BELT should be in good condition. Loosen it for best inspection. Diagrams show (arrows) where chain-adjusting nut is located on most chain cases.



TAKE UP the slack on brake cable so the brake lever is ¼ inch or more from handlebar when activated. You can't afford to have "soft" snowmobile brakes!



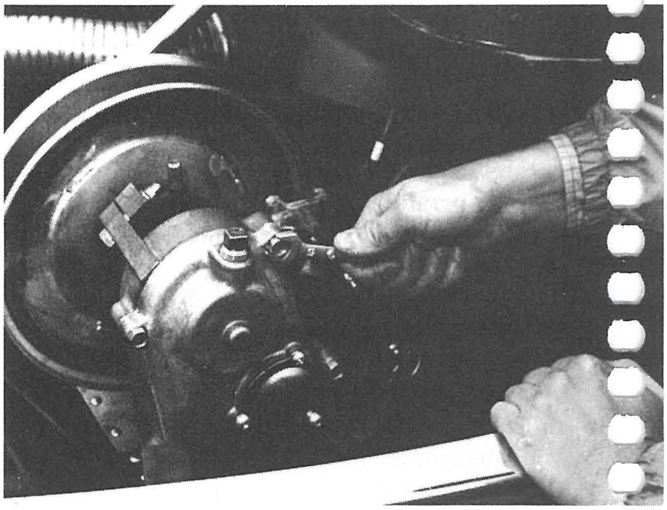
and Polaris tracks must support the vehicle as you make the adjustment. Checking and adjusting track tension is one service outlined in all owners' manuals. If you've lost yours, write the company for another.

- *Check track alignment.* Lift the rear of the machine off the ground and block the front end for stability. Start engine and run the drive mechanism to see if the track is centering squarely between the sides of the chassis and if the teeth on the sprocket wheel are entering the drive slots evenly. Track alignment is usually made by adjusting screws.
- *Check ski alignment and adjust if necessary.* Skis should parallel each other and the vehicle's body while the steering bar is in a straight-ahead driving position. If you don't trust your eye, measure the distance across the skis, front and rear, with a metal tape.

Ski adjustment varies. With some machines, such as Yamaha and Bombardier, loosen tie-rod nuts and turn tie rods to move skis in or out. With Mercury, loosen the mounting bolts of one ski spring pivot plate until it parallels the other. With Evinrude, loosen the jam nuts at outer ends of the tie rods, remove locknuts from the outer ball joints, and turn ball joints to align the skis. Polaris models are adjusted by turning the rod and bearings.

If you can't figure how to align your machine's skis (in many cases, the procedure isn't in the owner's manual), ask a dealer or write to the maker.

MODERN SNOWMOBILES are built to stand rough treatment. However, vibration causes nuts and bolts to loosen. Tighten these parts before the season starts.



Examine skis carefully. If runners are worn excessively, replace them.

- *Check drive belt for wear.* If it's cracked, frayed or worn, replace it. If it's unevenly worn, your drive and driven pulleys are out of adjustment.

Pulley offset—the relative position of one pulley sheave to the other—is generally about ½ inch; the exact dimension differs from machine to machine. If pulleys are misaligned, usually they must be removed, and shims added or damaged parts replaced. This job is best done by your servicing center.

- *Adjust drive train if too slack.* The drive chain connects the driven pulley to the drive axle. To check tension, remove the inspection cover and press in on the side of the chain. There should be a slight deflection. A chain that's too slack will jump on the sprocket, damaging the chain or sprocket. Adjustment usually is made by loosening a locknut and turning an adjustment mechanism, though some chains are self-adjusting.

Make sure the drive-chain case is filled with lubricant. If it isn't, add chain case oil available at your local snowmobile dealer.

- *Adjust brakes if brake lever is less than ¼ inch from the handlebar when brakes are engaged.* Adjustment usually involves loosening the brake cable at the brake-shoe mounting and taking up the slack cable.
- *Tighten all bolts and nuts and lubricate all appropriate points.* A lube chart should be in your owner's manual. Remember: grease and oil are cheap compared to damage their nonuse causes.
- *Check the battery.* If your machine has electric start, make sure the battery electrolyte is up to level, terminal connections are tight and free of corrosion, and the battery is clean. If battery is dirty, remove it from the machine and wash with a baking soda solution or ammonia, taking care not to get any inside the unit. Rinse the battery thoroughly with water. Reconnect terminals tightly and coat them with a light layer of petroleum jelly to retard corrosion.

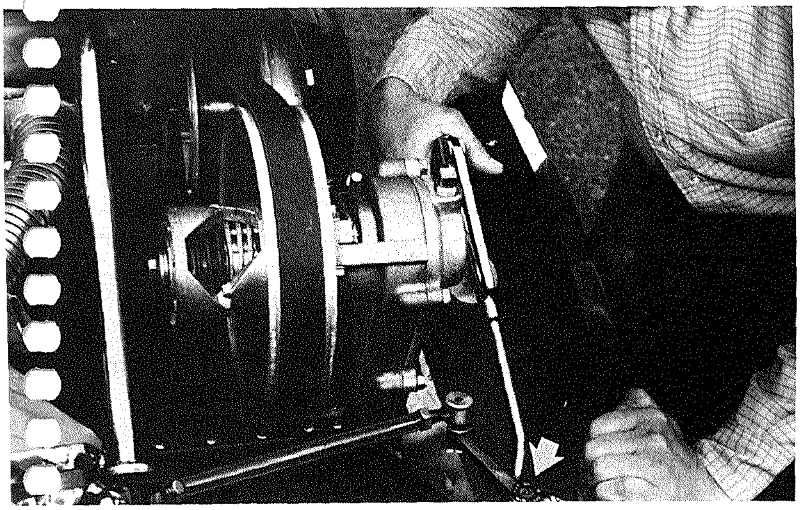
Start the engine and listen for "wrong" sounds. If you know anything about small-engine maintenance and repair, you can apply much of it to snowmobile engines.

- *Examine the machine's exterior.* For any scarred areas, use a touch-up paint you can usually get at your snowmobile dealer's. Wet-sand damaged area with No. 320 sandpaper, using a circular motion. If damage is deep and you have to sand to base metal, apply a zinc chromate primer before painting.

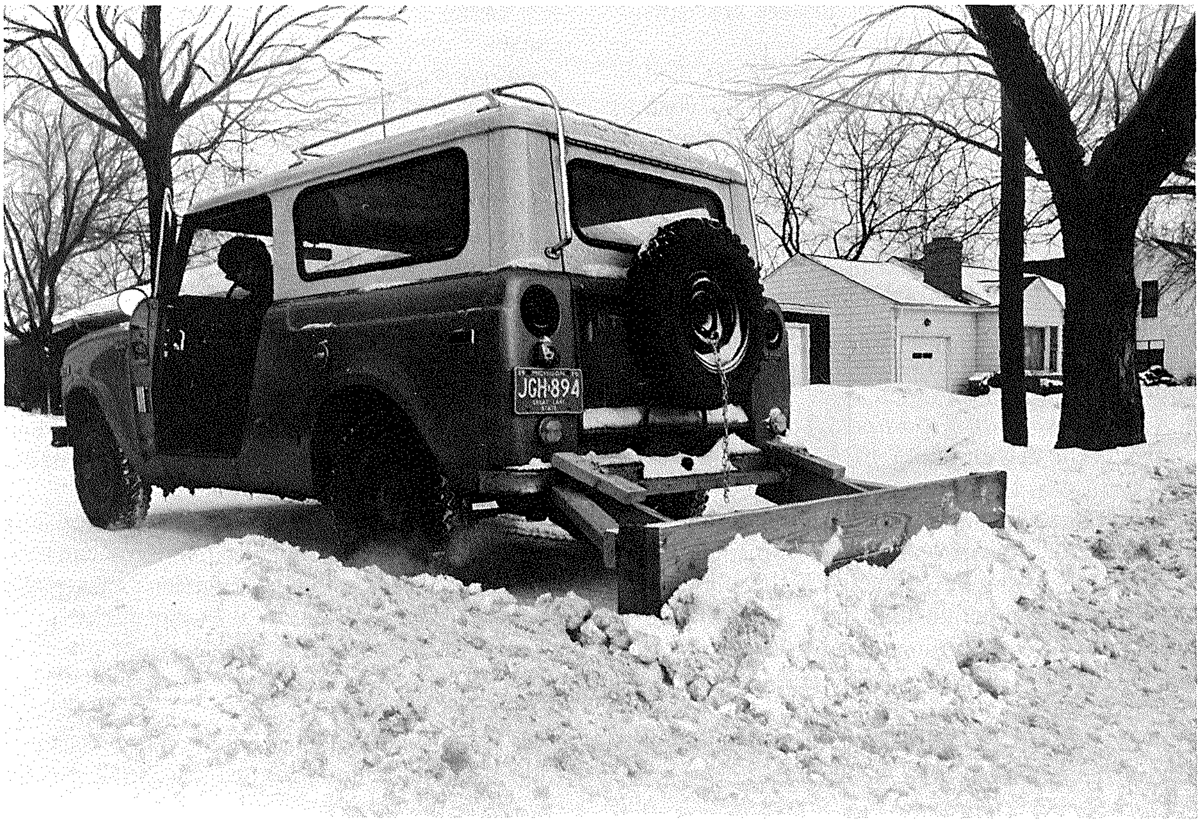
For a minimum of engine work at the start of a season, you should clean or replace the fuel filter; check the fuel line (replace if it's dried out); replace sparkplug(s) if damaged or worn; clean and regap old plugs if reusable and adjust the carburetor.

Don't assume the carburetor is set properly because the machine ran okay when you stored it. A change in temperature may affect adjustment.

MOST IMPORTANT service you can give your machine is lubrication. Always lubricate before and throughout the entire season. Follow the lube chart found in the owner's manual.

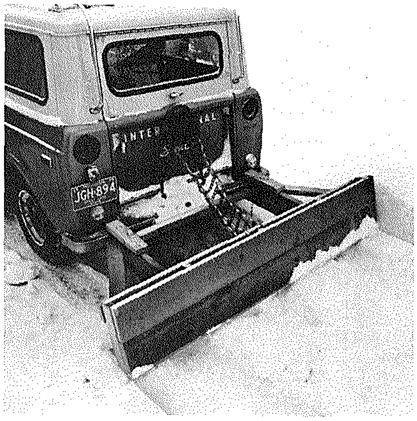


CARBURETOR ADJUSTMENT may be required. Proper fuel flow to your power system is especially critical.



Clear your drive the easy way

By FRANK M. BUTRICK



PLOW IS attached to the vehicle by chains wrapped around bumper, then hooked over the projecting nailhead.

SEE ALSO

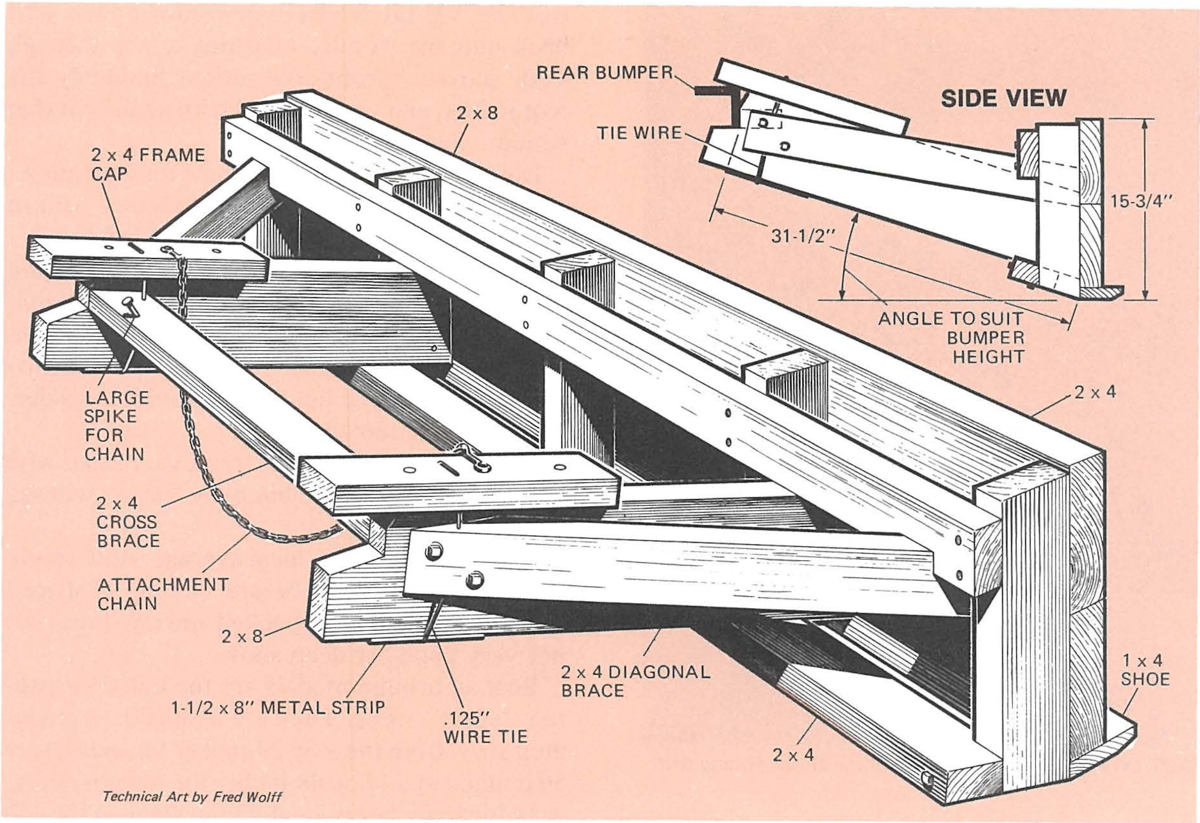
Asphalt driveways . . . Snowblowers . . .
Tractor lifts . . . Tractor trailers . . . Yard machines

■ WITH EACH PASSING year I've noticed that the snow is getting heavier. So during a recent winter, I did something about my long driveway—which seemed almost endless after a heavy snowfall.

I made a snowplow—at a cost of only $11.93 and four hours' work with hand tools. Since it weighs only 90 lbs., I built it in my basement and then dragged it up the stairs. I don't claim it will do everything that a $300 unit will—you have to get out to lift the blade after each run. And it will ride on top of hard ice or frozen snow, rather than scrape it. But that's small inconvenience for the $288 price difference.

Design yours to suit your vehicle. The one shown fits the rear bumper of a Scout. Or the plow can be scaled down for use on a family car equipped with studded snow tires or chains.

A primary consideration is providing the means for attaching a chain (or mounting): a sturdy luggage rack, trunk opening, trunk



Technical Art by Fred Wolff

handle, or—on the front end—a loop of heavy wire fastened to the radiator support and arranged to project when the hood is closed. The suspended weight is only 65 lbs., so the selection is more convenience than engineering.

Make a full-sized sketch of the side of the plow, showing your bumper cross section the proper distance from the ground. Lay out the plow face and the angle of the frame and draw the bumper notch, remembering that the plow must have good bearing on your bumper when down, and must not bind when you lift it. Leave heavy stock below the bumper, and use a separate frame cap to support the raised bumper end of the frame.

Lay out the frames and saw them. Space the frames to suit your bumper supports, trailer hitch, or any place that will take the thrust. Nail the vertical ribs to the 2x8s of the plow face, letting the ribs project ⅝ in. below the lower 2x8 to back up the 1x4 shoe. Then nail the frames to the proper ribs, leaving enough space below the frames for the lower stiffener. It is notched to provide good bearing against the ribs to which they are nailed as well as to the frames. A 2x4 is cut to fit between the frames at their bumper end and nailed in place, using two small nails to avoid splitting. Cut and fit the diagonal braces and nail them in place. The upper stiffener rests on the frames and is notched to fit the diagonals.

The joint where the frames, crosspiece, and diagonals meet is nailed sparingly (to prevent splitting the lumber). For reinforcing, force a heavy wire through drilled holes, wedge and twist it tight, and nail down the sharp ends.

Consider the shoe as expendable. In my rough driveway I expect it to last, at the most, one or two seasons. Thus, make it from any inexpensive wood. I used a length of 1x4 furring and beveled it to ride over broken concrete. If your drive has a smooth tie-in with the street, you can probably leave the edge square.

A heavy dog chain provides the attachment and lift chains. Decide where the attaching chain can pass around your bumper and provide some lateral control. The lift chain is 3 ft. long and has a heavy ring at one end and a hook at the other.

Using my plow with the Scout, I have moved hundreds of pounds of loose, broken-up ice and plowed through two-ft.-high snowdrifts.

TAUT COWHIDE web keeps a hunter afloat on any drift.

Snowshoe basics

By JOHN POWER

Snowshoes are getting more popular all the time. In many places they are considered standard equipment for snowmobilers, and in any snowy location they are the basis of a great recreational sport

YOU'VE GUNNED your snowmobile well back into the woods, smashing a trail through deep snow far from civilization. Suddenly the motor dies, and you're faced with a hike out that would exhaust a moose.

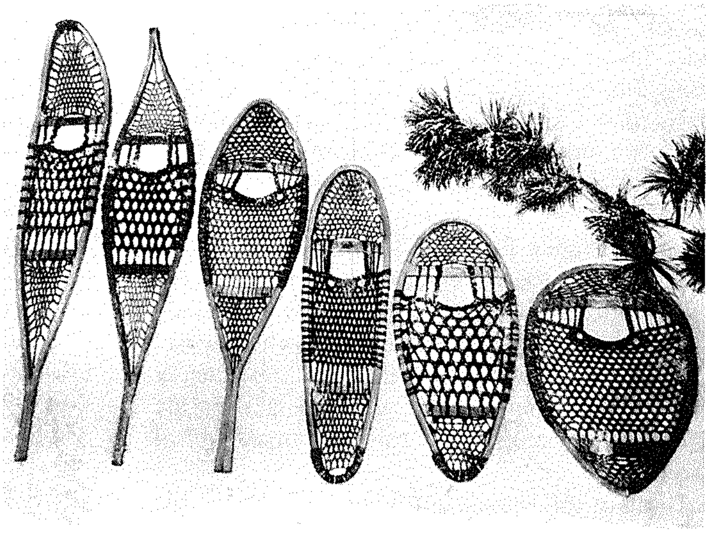
But you reach into the machine for your snowshoes, strap them on, and in minutes you're moving comfortably over five-foot drifts.

That bit of fiction isn't as farfetched as you may think. Some states now require snowmobilers to carry "snow racquets" for such emergencies. Even more persons are taking up snowshoeing just for the fun of it. If you're considering the sport, remember:

Make sure the white ash frames are laced with heavy-duty cowhide. Thin belly leather will sag in wet snow.

Check your weight, local average snow conditions and the terrain before buying. Flat-toed shoes are fine for hard-packed and icy slopes but not very good for deep snow.

Best all-around models are the tailed curved-toe "sport" webs. They are available in graduated sizes from the 9 by 29-incher for kids under 50 pounds to a 14 by 48-incher for 200 pounders. A 14 by 42-incher is ideal if you weigh in the 150 to 175-pound range.



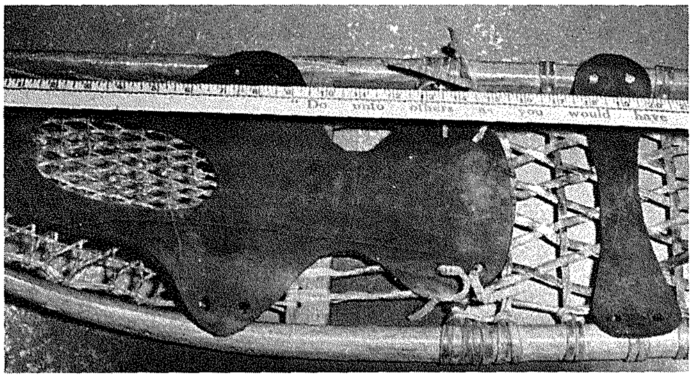
SNOWSHOES come in at least 50 different models. It is important that you pick the ones designed for your job or type of snow and terrain. Six of the most popular styles are (left to right): U.S. Army, Ojibway, sport, the tailless otter, bear paw and beavertail. The 10-inch-wide Army and 12-inch-wide Ojibway, each five feet long, are handy for cross-country travel with the tail keeping you going on a straight line. The 14 by 30-inch bear paw is most popular with trappers. The "animal shoes" are not particularly good for deep snow.

SEE ALSO

Backpacking . . . Binoculars . . . Camping . . . Clothing, winter . . . Hunting . . . Ice skates . . . Skis, snow . . . Snowmobiles

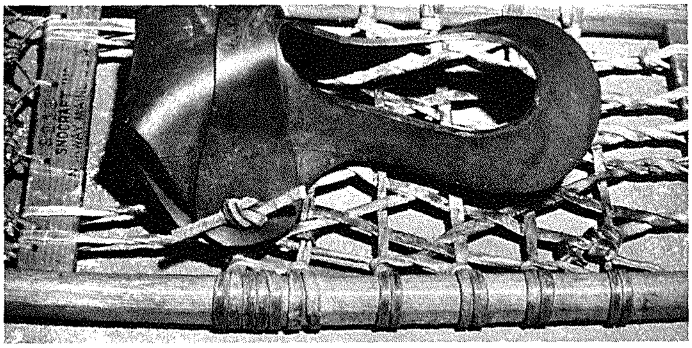
Make snowshoe bindings from an inner tube

By FRANK R. MARTIN

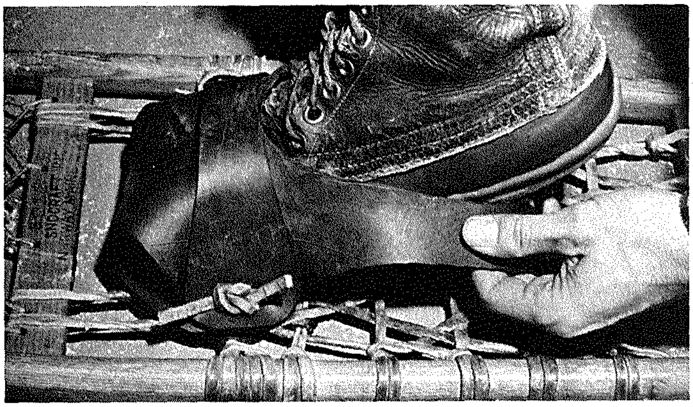


SNOWSHOES ARE becoming more and more popular with the increased use of snowmobiles. For weekend snowmobile trips into the wilds, it's a must to take along at least one pair of snowshoes. They're virtually indispensable if you have to walk out of the woods.

You can make your own snowshoe bindings without cost from a discarded truck-tire inner tube. The bindings shown here are for a size-nine boot. Adjust the pattern to fit your own shoe. Note the shape of tie-down strap in photo.

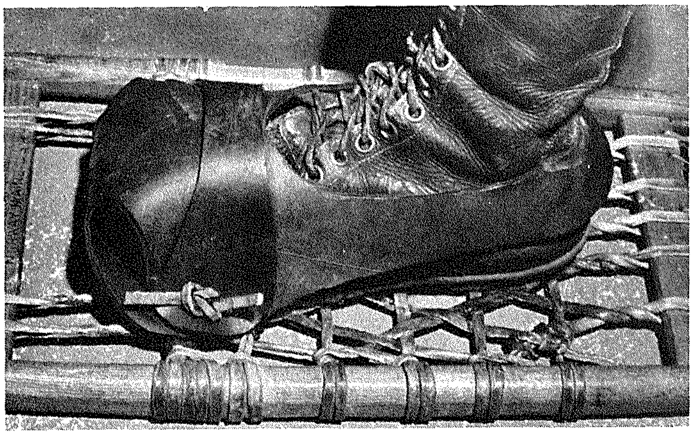


ONCE YOU'VE CUT the two necessary pieces from an inner tube, lace two rawhide thongs through the snowshoe and holes in the sole of the binding as seen in the photo above. Then fold the toe piece back. Place the toe straps in position. Thread rawhide through the holes in the toe strap. Secure with a good square knot.



INNER-TUBE TENSION will keep the snowshoe binding tight to the boot. Reinforcing the toe strap adds considerable strength to the binding. Notice the closed toe at the front of the binding. This prevents snow and ice from getting packed under the ball of your foot when you're traveling in deep snow.

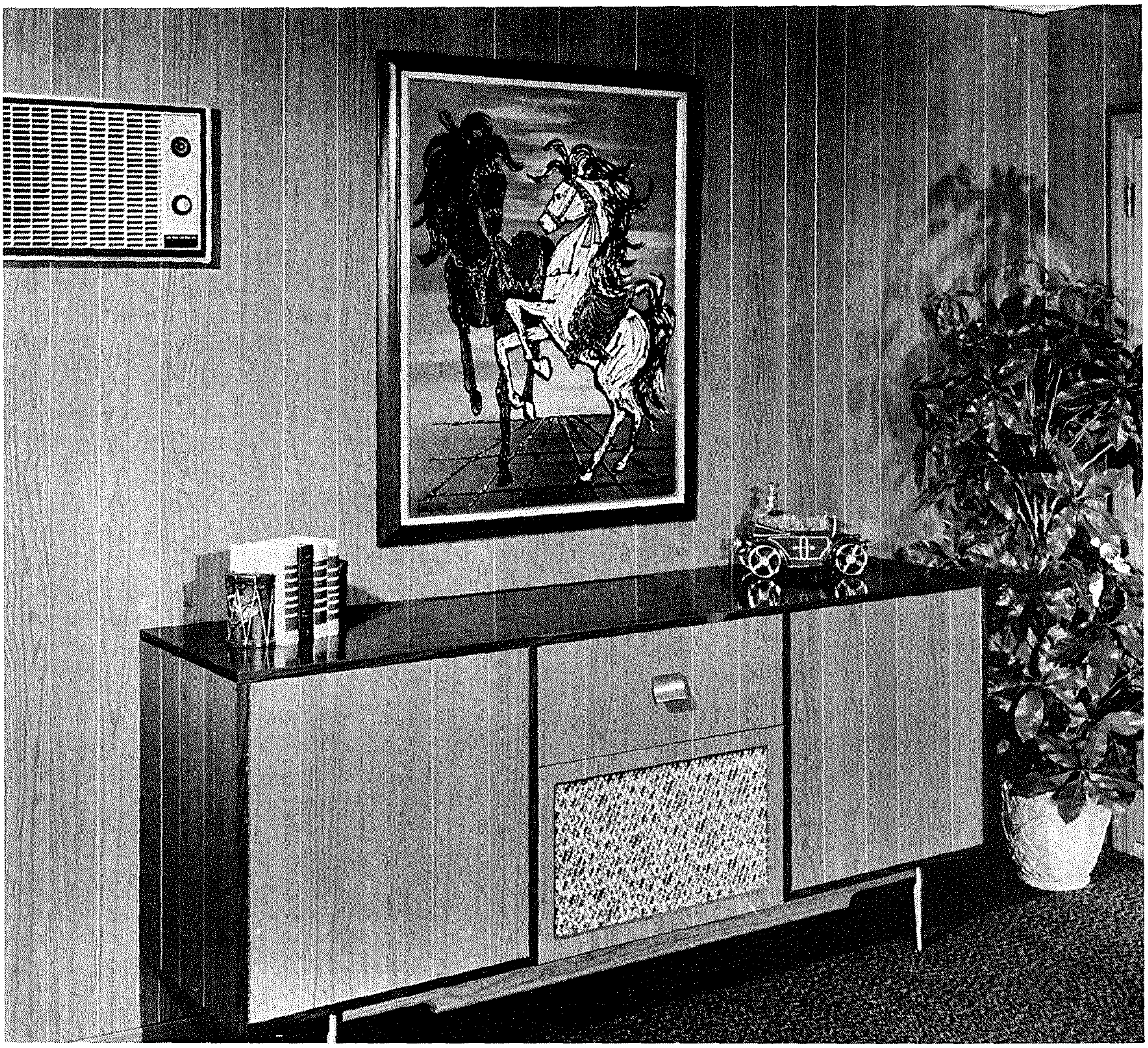
When making new bindings, it's a good idea to make an additional pair in case you need them out in the field. It's a good idea, too, to make up an emergency pair even if the bindings now on your snowshoes are in decent shape.



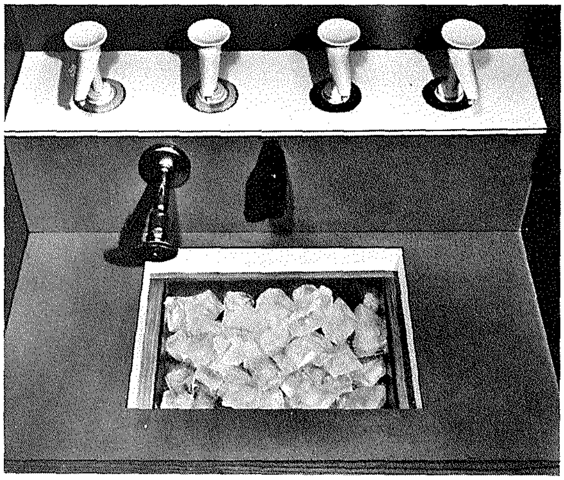
YOUR BOOT SLIPS into the binding as shown in photo at left. Pull back on the heel strap to secure the boot. Flex the boot to make sure you can walk properly with your new bindings. The toe should fit easily into the open slot in the bottom of the snowshoe.

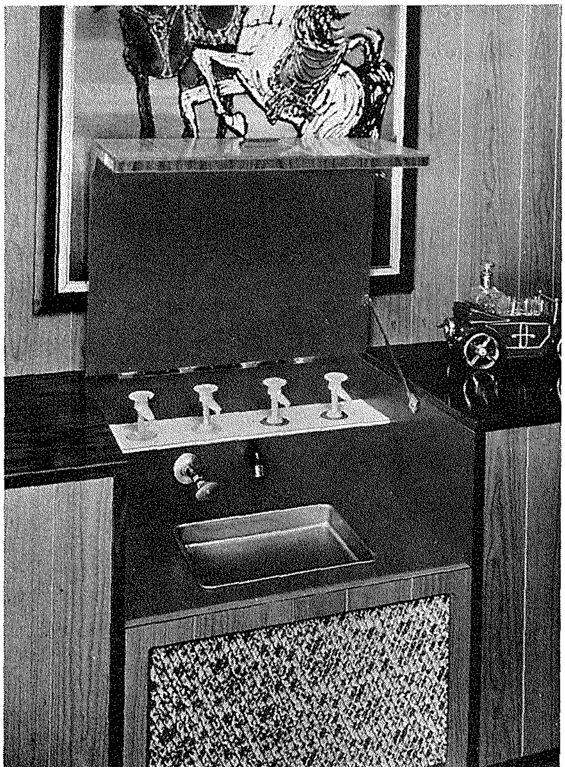
SEE ALSO

Backpacking . . . Binoculars . . . Camping . . . Clothing, winter . . . Hunting . . . Ice skates . . . Skis, snow . . . Snowmobiles



ICE-CUBE BIN under lift-out tray holds a goodly supply. Bin is stocked from the kitchen refrigerator.





Build yourself a soda fountain

By **WAYNE C. LECKEY**

It's fun to make your own carbonated beverages at home—and a lot cheaper, too. This handsome cabinet encloses dispensing, carbonation, and refrigeration equipment plus storage

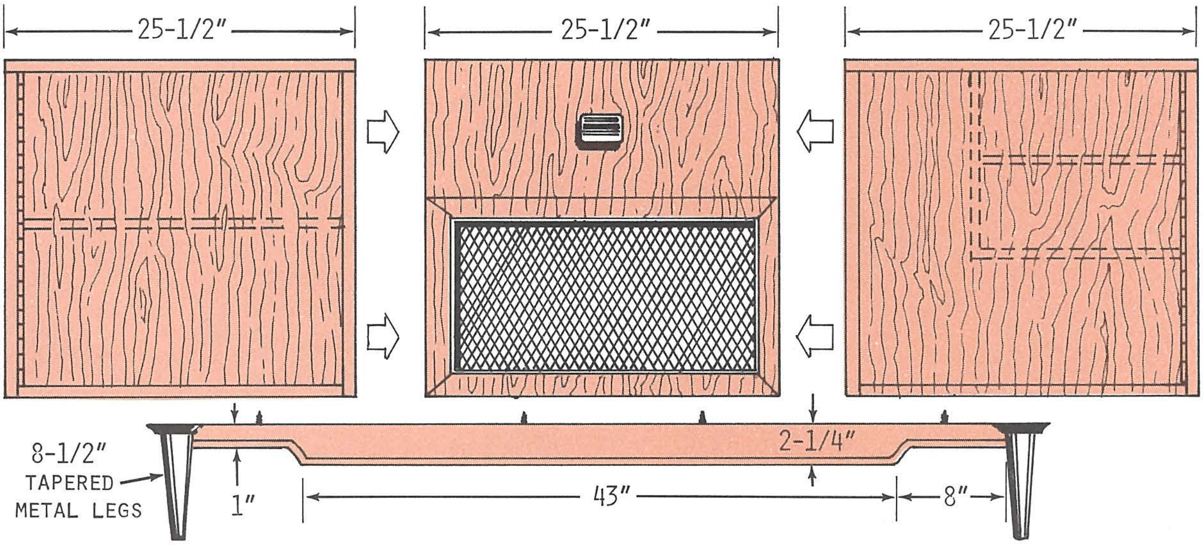
LEFT-HAND CABINET with adjustable shelf provides handy storage for bulk-syrup stock, glasses, napkins, other items. Rod on door keeps towel handy. Roomy cabinet will also serve as liquor cellarette.

■ OVER A PERIOD OF TIME, two or three soft drinks for the price of one add up to a sizable saving for the average soda-drinking family.

Check with a local soda fountain or restaurant to see what they'll charge you for a gallon of syrup to make your favorite cola or other soft drink. Divide that figure by 128, the number of ounces in a gallon, to get the price of an ounce. One ounce of syrup when mixed with five ounces of carbonated water makes a standard 6-ounce drink at a fraction of the fountain cost.

Figuring everything, the cost of the syrup, the carbonated water and the electricity to run your fountain, home sodas probably can be made for half or less the amount per ounce that you'd pay for the same beverage in cans.

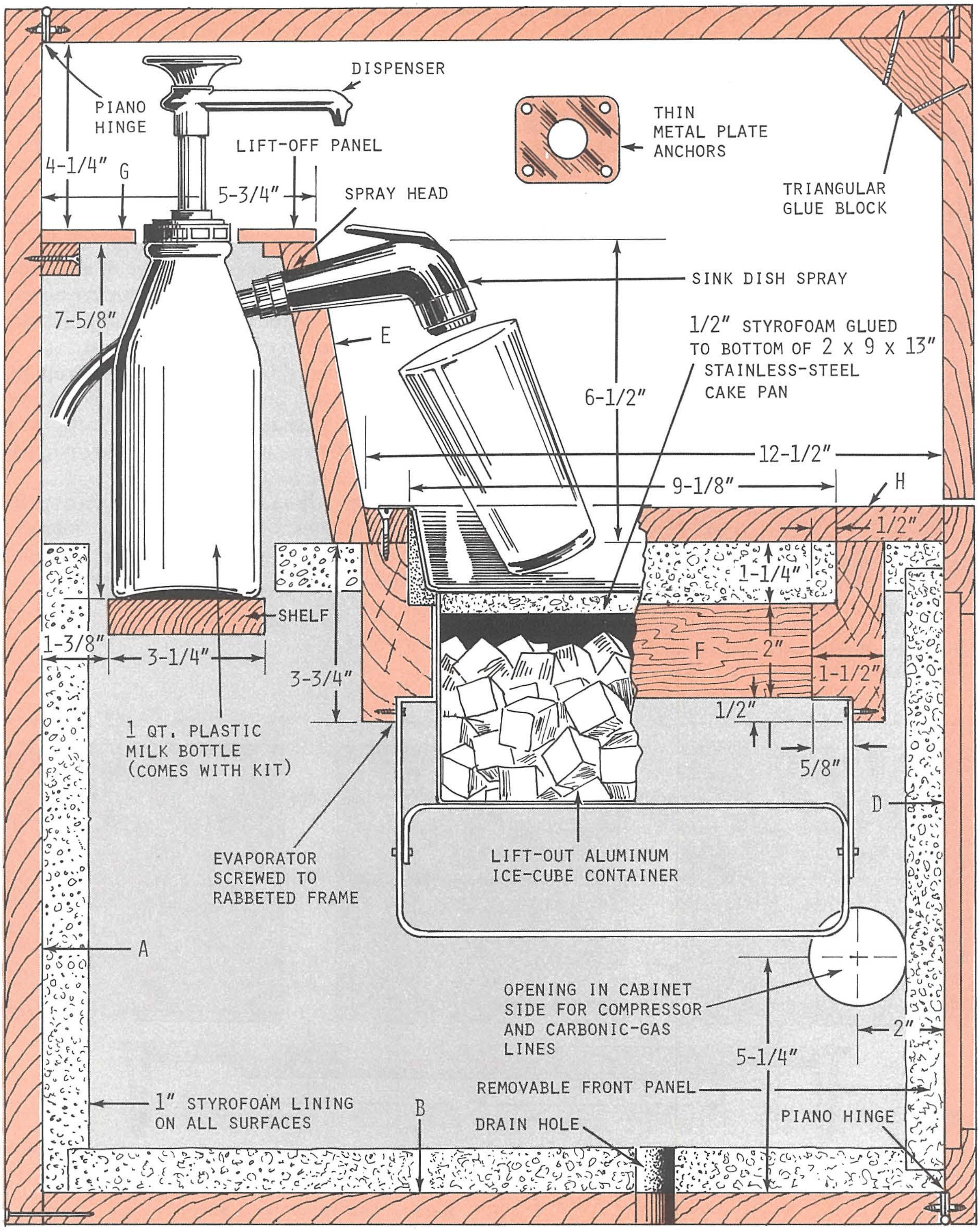
At this rate a home soda fountain soon pays for itself and makes what might be considered a sheer luxury into an item that is as economical to own and operate as a kitchen refrigerator.

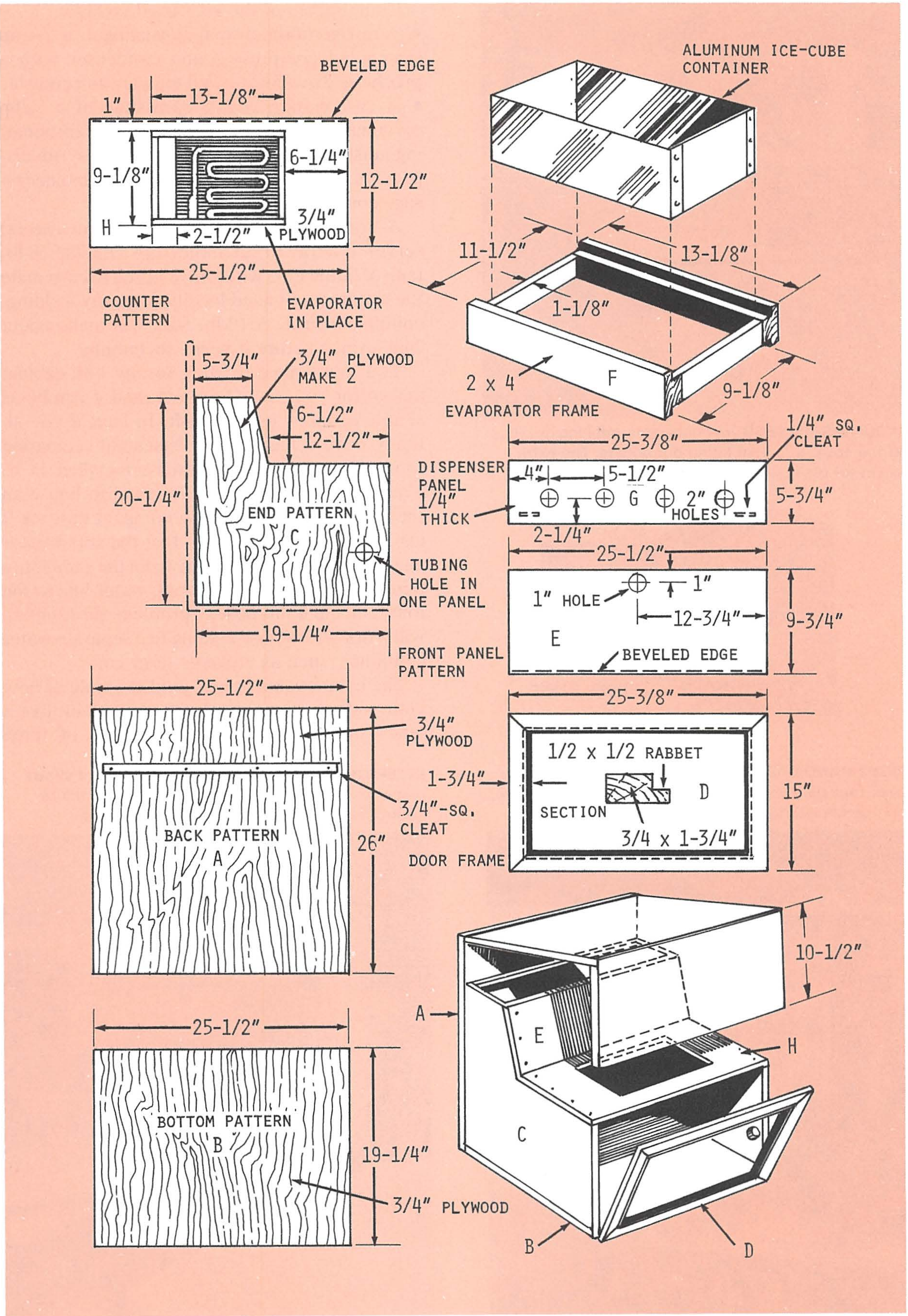


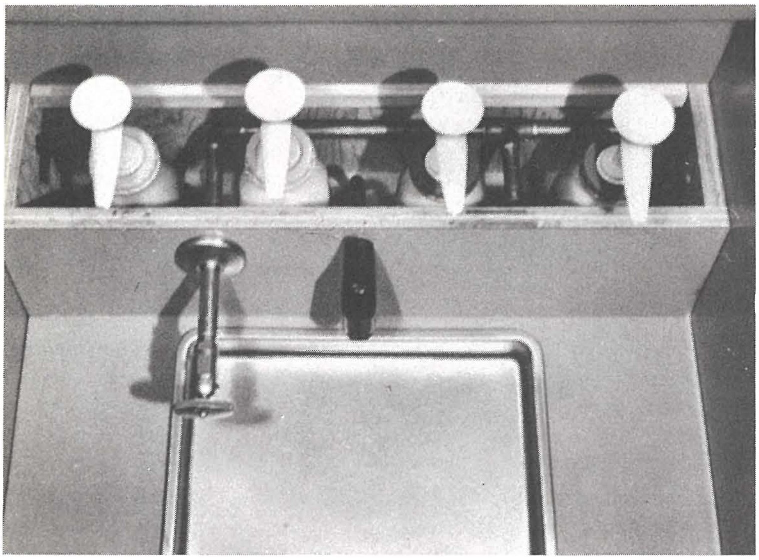
SEE ALSO
Bars . . . Family rooms . . . Servers

The convenience of a home soda fountain cannot be overlooked. For one thing it's extra handy and even fun to use, and the fact that you can forget about the return of bottles and the disposal of cans, as well as the chore of lugging them home from the store, makes for a lot less bother.

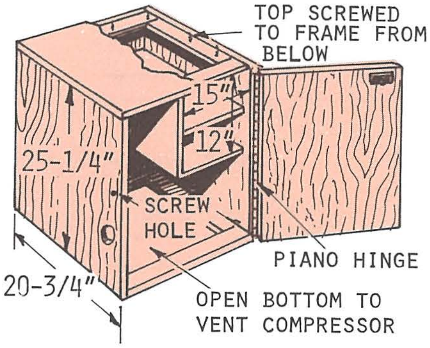
You'll discover for yourself why almost every restaurant and soda fountain uses this system, rather than cluttering up their premises with cans and bottles. You can host a large party or supply a throng of thirsty teen-agers with much less fear of running short, and without an extra trip to the grocery or package store.


DISPENSER
PIANO HINGE
LIFT-OFF PANEL
4-1/4"
G
5-3/4"
SPRAY HEAD
THIN METAL PLATE ANCHORS
TRIANGULAR GLUE BLOCK
SINK DISH SPRAY
7-5/8"
E
6-1/2"
1/2" STYROFOAM GLUED TO BOTTOM OF 2 x 9 x 13" STAINLESS-STEEL CAKE PAN
12-1/2"
9-1/8"
H
1/2"
1-1/4"
SHELF
F
2"
1-1/2"
1-3/8"
3-1/4"
3-3/4"
1/2"
5/8"
1 QT. PLASTIC MILK BOTTLE (COMES WITH KIT)
D
EVAPORATOR SCREWED TO RABBETED FRAME
LIFT-OUT ALUMINUM ICE-CUBE CONTAINER
A
OPENING IN CABINET SIDE FOR COMPRESSOR AND CARBONIC-GAS LINES
2"
5-1/4"
REMOVABLE FRONT PANEL
1" STYROFOAM LINING ON ALL SURFACES
B
DRAIN HOLE
PIANO HINGE

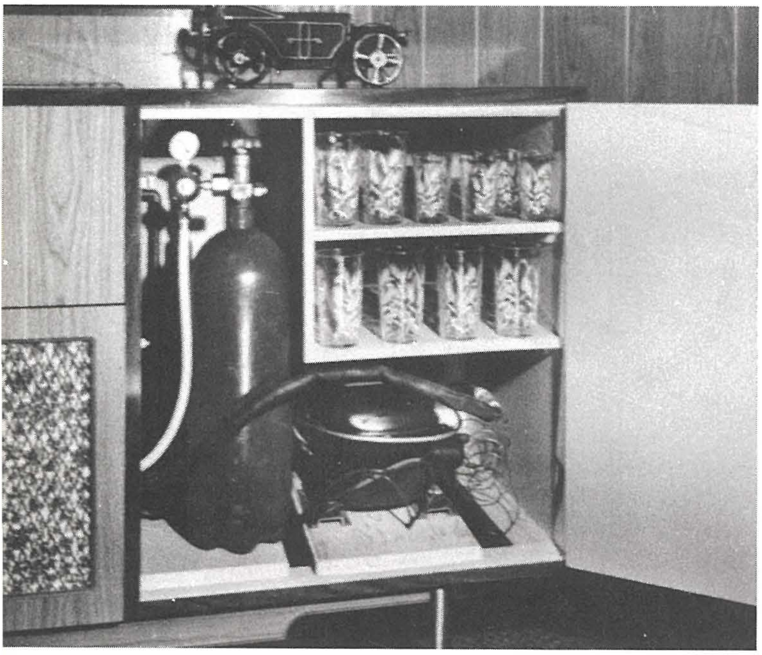

BEVELED EDGE
1"
13-1/8"
9-1/8"
6-1/4"
12-1/2"
H
3/4"
2-1/2"
PLYWOOD
25-1/2"
COUNTER PATTERN
EVAPORATOR IN PLACE
ALUMINUM ICE-CUBE CONTAINER
11-1/2"
13-1/8"
1-1/8"
2 x 4
F
9-1/8"
EVAPORATOR FRAME
5-3/4"
3/4" PLYWOOD MAKE 2
6-1/2"
12-1/2"
20-1/4"
END PATTERN
C
TUBING HOLE IN ONE PANEL
19-1/4"
25-3/8"
1/4" SQ. CLEAT
DISPENSER PANEL 1/4" THICK
4"
5-1/2"
G
2" HOLES
5-3/4"
2-1/4"
25-1/2"
1" HOLE
1"
12-3/4"
9-3/4"
E
BEVELED EDGE
FRONT PANEL PATTERN
25-1/2"
3/4" PLYWOOD
3/4"-SQ. CLEAT
BACK PATTERN
A
26"
25-3/8"
1/2 x 1/2 RABBET
1-3/4"
D
SECTION
3/4 x 1-3/4"
15"
DOOR FRAME
10-1/2"
A
E
H
C
25-1/2"
BOTTOM PATTERN
B
19-1/4"
3/4" PLYWOOD
B
D



SYRUP DISPENSERS are removed for refilling by lifting off the cover and then lifting out bottles. The extra faucet for plain water is optional.


TOP SCREWED TO FRAME FROM BELOW
15"
12"
25-1/4"
SCREW HOLE
PIANO HINGE
20-3/4"
OPEN BOTTOM TO VENT COMPRESSOR

RIGHT-HAND CABINET houses compressor and CO_2 tank. Tank gauge should read 120 lbs. pressure. Shelves over compressor provide glass storage.



Components of the kit I used include:

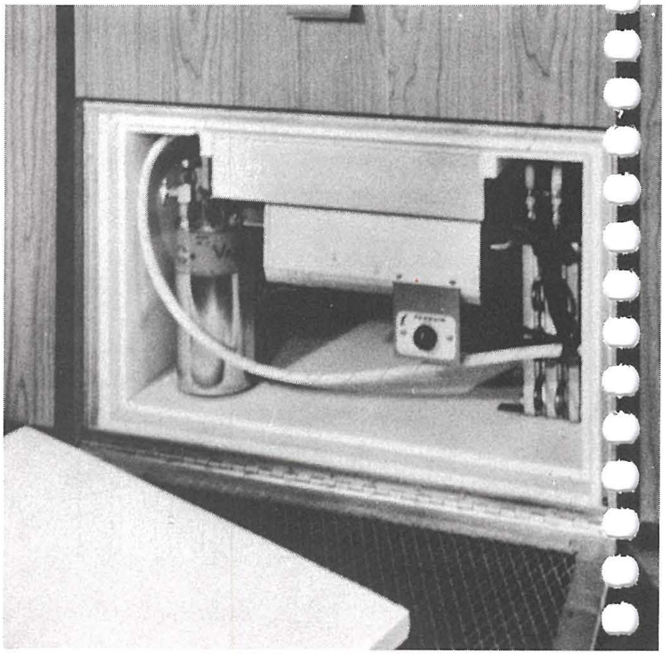
- A refrigeration system consisting of a $^1/_{12}$-hp fan-cooled compressor and condenser with a precharged evaporator and temperature control.
- A carbonating circuit consisting of a ¼-hp carbonator and pump, stainless-steel carbonating tank, cold bank, faucet, four 1-qt. syrup dispensers, CO_2 valve and gauge, hoses and necessary connectors.

A common stainless-steel cake pan (Sears) serves as a tray to catch the drips, and the 10-lb. tank of liquid CO_2 which is required to carbonate the water, is obtained locally from any welding-equipment firm. A 10-lb. tank will make about 2400 drinks before it needs recharging.

You don't have to stick to any one cabinet design for your soda fountain, and it can be as simple or fancy as you wish. In fact, if you already have a bar in your basement recreation room, the components can be installed in it. Your cabinet also can be designed to house all the components in a single compact unit, or it can be made in such a way that the compressor and the CO_2 tank are remote from the soda fountain itself. I brought a separate water line to the fountain, but if this poses a problem, the fountain will work with a hose leading to a separate water container, such as a plastic jerry can.

The cabinet shown is a good example of how your soda fountain can be made to look like a fancy piece of furniture. It consists of three

INTERIOR VIEW of refrigerator compartment shows placement of carbonator, evaporator, temperature control and cold bank. Note Styrofoam panel.



separate cabinets bolted together side by side. The center one is actually the soda fountain, which has an insulated compartment that houses the evaporator, cold bank, carbonator unit and syrup dispensers. The flanking right-hand cabinet houses the compressor and the CO_2 tank, while the left-hand cabinet provides storage for bulk syrups, glasses, napkins and other items.

A 4-in.-deep container formed from DIY aluminum sits in the evaporator and holds a goodly supply of ice cubes under the lift-out drip tray. It's kept filled with ice cubes from the kitchen refrigerator.

The carbonator pump runs only when you are dispensing sodas. You can draw about three drinks from the tank before the pump turns on. It takes less than 10 seconds to refill; then the pump shuts off.

The four syrup dispensers are refilled by lifting cover G up over the tops and lifting out the plastic bottles which sit in a row on a narrow shelf.

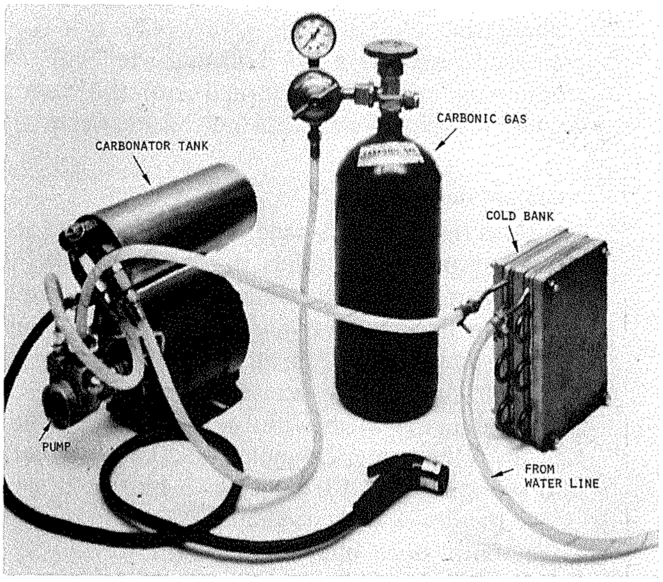
The kind of wood for your cabinet is up to you. I used fir plywood and covered the front and ends with ¼-in. prefinished paneling because I wanted the cabinet to match the wall. I faced the top and inside with a slick plastic laminate. You may prefer to cover the whole thing with plastic laminate. Then again you may prefer to use nothing but hardwood-faced plywood for the exposed parts and tape the edges. Whatever wood you choose, the area around the dispensers and tray should be covered with plastic laminate.

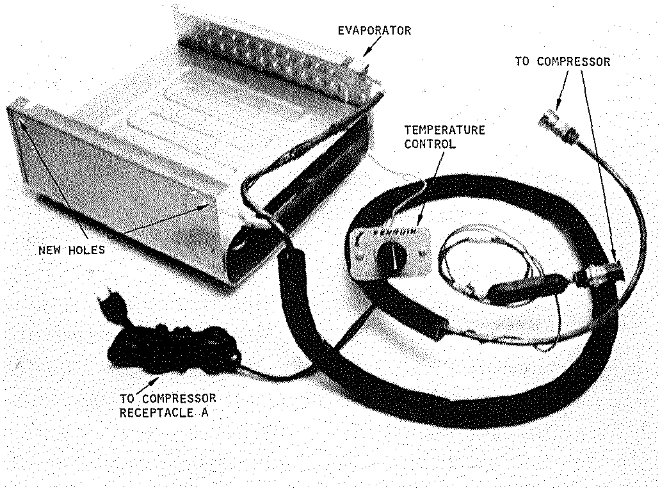
making the cabinet

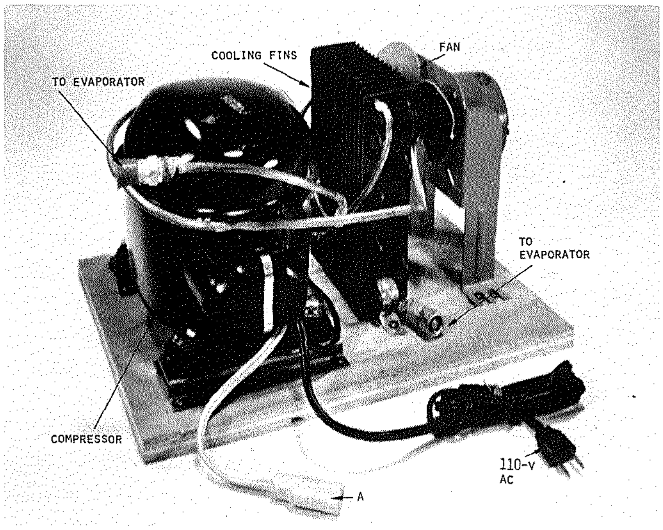
If you decide to copy the very cabinet I made, start with the center unit. Cut the parts from ¾-in. plywood, following the dimensions given. The two sides, parts C, are identical except for the 2-in. hole which is made only in the right-hand member. Cut the opening for the cake pan in part H, and bore the hole in part E for the special faucet. Now, nail and glue the six parts together.

The two pieces which form the lid are joined at the front in a rabbet and then reinforced on the inside with a husky triangular cleat. You'll do best to wait until the three cabinets are bolted together before making and fitting the lid since it must have $^1/_{16}$-in. clearance along each side so it will open without rubbing. The lid projects ¾ in. at the front and rests on the edge of the tip-out access door to the refrigerator compartment. A long desk-lid support holds the lid open.

Refrigeration System of Kit







The door, part D, is mitered like a picture frame, hinged along the bottom and fitted with a decorative cloth-backed wire grille. It's kept closed by a screw inserted through a hole in each adjoining cabinet and turned into the door's edge. It's best to wait until later to add the door.

cabinet details

Both right and left-hand flanking cabinets are simple boxlike assemblies, made alike except for the bottom of the right-hand one. This is merely an open frame to provide adequate ventilation for the compressor. The other cabinet has a solid bottom. A 2-in. hole is also made in the side of this cabinet to align with the hole made previously in the center cabinet. The doors are made to swing right and left on piano hinges. If you face the doors with plastic laminate, remember that both sides must be covered to equalize stress and avoid bowing. I used touch latches on the doors, but regular knobs and magnetic catches will do.

The three cabinets are ganged together side by side and holes are drilled through the butting sides for ¼-in. carriage bolts, placed below the tray level.

The evaporator hangs from a rabbeted wooden frame, part F, below the tray opening. This is made as a separate unit and then glued and screwed to the underside of the opening. Study the section drawing on page 2832. Four small screw holes are drilled through the side of the evaporator for attaching it to the rabbets. Note in counter pattern H, page 2833, that the evaporator is located off center of the opening so that the refrigerant lines across one end of it won't interfere with placement of the liftout ice-cube container.

applying insulation

The lower compartment of the center cabinet is lined (back, sides, bottom, top and front) with rabbeted panels of 1-in. Styrofoam. Install the back lining first, then the bottom, followed by the side panels. Separate pieces are cut to fit around the evaporator frame when lining the underside of the top. These are stuck in place with white glue. The front panel is a mere press fit in the rabbets since it must be left removable.

Aside from screwing ready-made tapered legs to the bottom and bridging between them at the front with a decorative apron, you are ready to install the components. After its refrigerant lines are passed through the 2-in. hole into the adjoining cabinet, the evaporator is screwed in place. Then the cold bank is placed along one side of the evaporator and the carbonator unit on the other.

The hookup of the components is simple. First the water-line hose is connected to one flare fitting on the cold bank. Then a second hose is attached to the other fitting on the cold bank and connected to the water-intake fitting on the carbonator pump. A third hose runs from the CO_2 fitting on the carbonator tank to the pressure gauge on the CO_2 tank. Finally, the hose from the soda faucet is attached to the "soda out" fitting on the carbonator tank. The CO_2 and water hoses, plus the carbonator motor cord and the temperature-control cord, all pass through the 2-in. hole. Poke a hole through the Styrofoam lining just big enough to pass the hoses and cords.

fitting the faucet

The soda faucet is held in place by a thin metal plate screwed to the rear side of the hole in panel E. The knurled nut on the end of the faucet is backed off and the hose inserted through the hole in the plate. When the nut is tightened, it locks the faucet in place. I added still a second faucet to make plain water available, but this is purely optional.

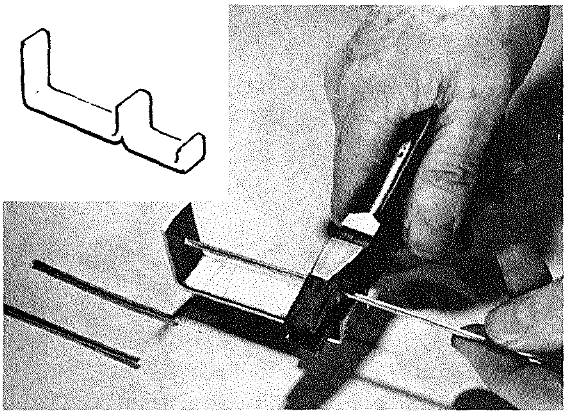
The compressor, mounted on a board base, rests across the frame of the open-bottom cabinet. Pieces of foam-rubber kneeling pad are used to cushion it. The CO_2 tank stands on a small shelf installed at the front corner. Connecting the two evaporator lines to the compressor fittings completes the hookup.

Once the compressor hookup is made you should not disconnect it for any reason. The compressor lines come charged with refrigerant and, once the seal is broken by tightening the connections, the latter must remain intact. Otherwise, you will lose the refrigerant.

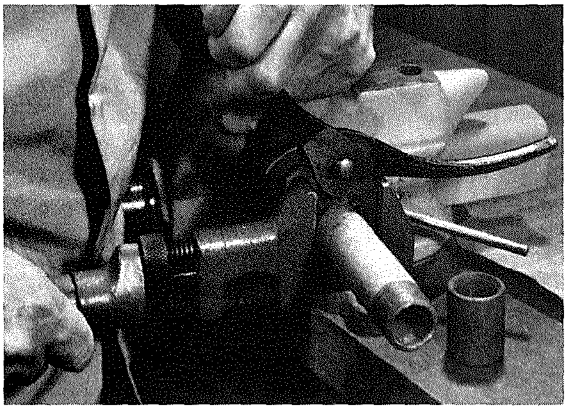
. . . and you're in business!

To use your soda fountain, plug the ¼-hp motor into one side of a 110-v. double wall receptacle. Then plug the temperature control cord into plug A and plug the compressor cord into the other side of your wall outlet. Now turn on the water to fill the carbonator tank and open the valve on the CO_2 tank so the gauge reads 120 lbs. pressure. Purge the air from the carbonator by opening its safety valve momentarily and you are ready for your first refreshing drink.

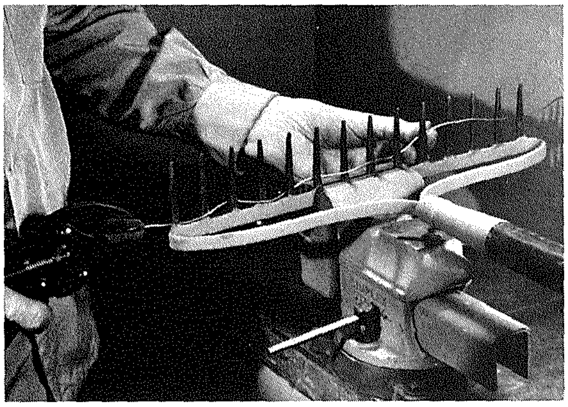
The complete kit of components, less CO_2 tank, is available from Home Soda Fountains, Inc., 19-41 46th St., Long Island City, NY 11105.



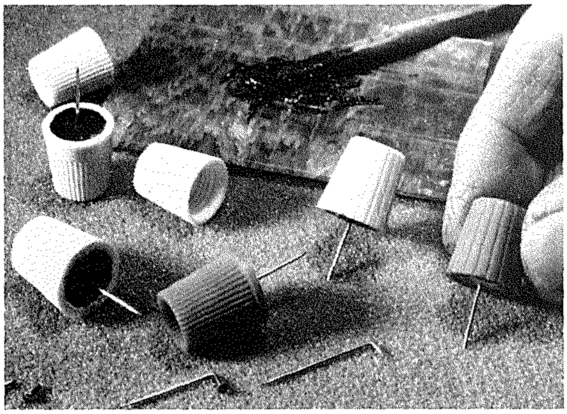
WHEN A JOB requires several short, uniform lengths of wire, this simple gauge for use with your wire-cutting pliers will enable you to cut them to identical lengths. Make it by bending a strip of sheet metal to form two troughs—a narrow one for the pliers and a wider one to match the wire length. The narrow one should be a press fit over the pliers.



USING ONE JAW of a pair of pliers, you can easily turn a monkey wrench into a pipe wrench. Place the plier jaw between the wrench jaws and tighten it against the pipe in the usual way. This will allow you to turn the pipe in one direction. By reversing the position of the plier jaw, you can turn the pipe in the opposite direction. Naturally, the thicker the jaws of the pliers, the more teeth area to grip the pipe—so use as large a pair of pliers as possible.



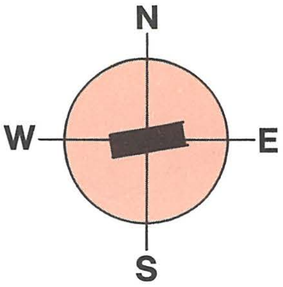
IF YOU WANT to take the kinks out of a length of small or medium-gauge wire, try drawing it through the tines of a garden rake. Just clamp the head of the rake in your vise, propping up the handle so as not to put an undue strain on the ferrule. Weave the wire between the tines, the spacing depending on the size of the wire and the amount of resistance needed to straighten it. Then grip the end with a pair of pliers and pull it through the tines.



SAVE THE PLASTIC CAPS from toothpaste tubes or similar containers, and you can use them in making jumbo pushpins for your bulletin board. Just fill them with any material that will harden (i.e., plastic auto-body filler or plaster of paris) and embed a pin headfirst in each so that it projects about ¾ inch. If the pins are too long, cut off enough from the head end to make them the right length and bend this end to a right angle for better anchoring.

Solar heating: what it is and how it works

BEST SHAPE for solar house is rectangle, with windowed face of house aimed slightly east of due south.



By DICK TERESI

■ SOCRATES WOULD LAUGH at the new "solar revolution." More than two thousand years ago he advised his fellow Greeks to build their houses facing south, with that side loftier to collect the winter sun, and the north side lower to keep out the cold winds.

But with cheap fossil fuels no longer cheap, we're finally rediscovering the sun. At this writing, solar energy is a $150-million-a-year business and, according to a Lou Harris poll, 80 percent of the American public favors a crash program to develop solar energy systems.

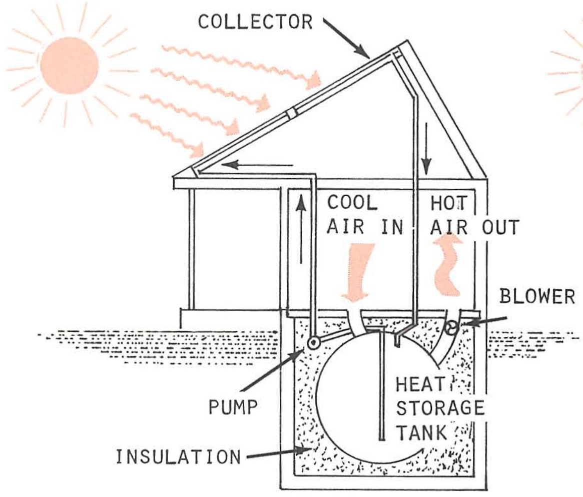
Before we get into the details of solar heating, you may have three questions on your mind: First, does it make sense to convert to solar heat if you don't live in America's Sun Belt? Second, how much does a solar energy system cost? And third, how much will it cut from your normal heating bills?

The answers: In only one area in the U.S. can solar heating be ruled out as impractical—the rainy Northwest where sun is scarce and conventional fuel costs are low. If you live anywhere else, even in the blustery Northeast, you probably can draw energy from the sun economically. Initial costs are undeniably high: A solar space heating system costs from $2000 to $20,000, with most systems in the $5000 to $10,000 range; water heating systems run from $600 to $2000. But if your house and area are good candidates for solar heat, experts say your utility savings should be no less than 40 percent.

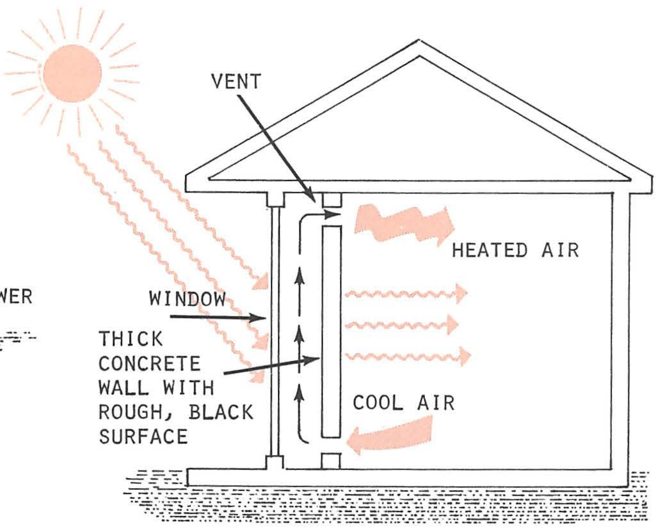
You need four things: sunshine, a way to collect it, someplace to store its heat and a way to circulate that heat through your house.

An active system is one that requires mechanical power—typically a pump—to help collect and move the heat around. The heart of the active system is the *collector*, usually a large flat piece of black metal that sits on the roof at an angle calculated to best catch the winter sun's rays. The collector's black metal absorbs the sun's rays and gets hot. A glass coating keeps the heat from escaping. A pump sends water or air to the collector to pick up the heat and bring it back down to a storage tank, which could be a water tank or an insulated pile of rocks. Then the heat is circulated through the house as it would be in any conventional system: through radiators, baseboard units or forced air ducts.

ACTIVE SYSTEM has mechanical input—in this case a pump that moves water from storage tank to roof collector; also a blower to move the air.



PASSIVE SYSTEM has no mechanical input. In this particular case a black concrete wall acts as the collector; air moves by natural convection.



A passive system uses no mechanical power to collect or distribute the sun's heat. And while it has a collector, it's not normally the elaborate roof-type found in active systems, but rather a large, thick wall, a small pond of water on the roof or perhaps a simple dark metal sheet hung behind a window. There *may* be a separate storage tank, but more likely the collector will also double as the tank, or the walls and foundation of the house itself will store heat.

Passive circulation depends on natural laws of convection, conduction and radiation rather than an elaborate arrangement of ducts and pipes. In short, passive systems are based on low technology. Because a passive system doesn't depend on fancy gadgets, but is designed as an integral part of a house, it is difficult to add to an already-existing home. But it can be quite effective when designed into a new house. And while it often requires some effort from a homeowner—to slide roof panels back and forth or adjust air vents and dampers—a passive system is also less prone to failure or maintenance problems.

backup heat

Almost all systems, active or passive, need an *auxiliary* heater, such as an oil furnace or wood stove, to carry the house through long periods of cold weather. Most systems can collect and store enough heat to meet 50 to 75 percent of a house's heating needs. A system could be built to provide all the heat, but it would be very large and expensive.

building a solar home

Before worrying about what kind of collector or circulation system to use, the solar homebuilder must keep the following rules in mind:

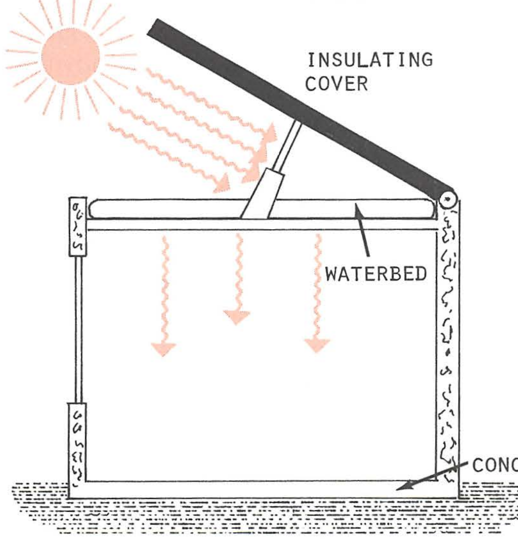
- Face the house south or within 30° of south. Some experts say it's best to face the house slightly east of due south to catch more sun in the cold morning hours when it's most needed.
- Don't build a square house. A rectangular structure, elongated along its east-west axis, will catch the most sun in proportion to its area.
- Follow conventional energy-saving wisdom. Have lots of windows on your southern exposure for a greenhouse effect. Insulate well. Keep the front high, the rear low.
- Control sunlight with drapes, blinds, awnings. Let the sun come inside when it's cold; shut it out when it's hot. A simple roof overhang can be a good solar device. Precisely calculated, it can let in all available sunlight in winter when the sun is lower in the southern sky, and shut it out completely in summer, when the sun is overhead.

The above tips are especially important for passive systems, which need every natural break they can get. But they also apply to active systems, even to conventional non-solar-heated houses.

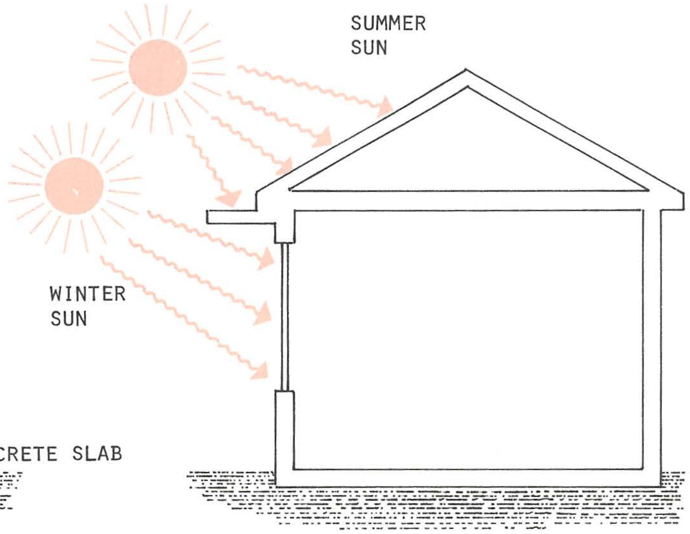
typical passive systems

The simplest passive solar house would be a *direct-gain* unit. This would be a house with large south-facing double-glazed windows to let

NOVEL PASSIVE SYSTEM has waterbed (or water bags) to trap the heat. Cover is lowered at night, and heat radiates down into the house.



ROOF OVERHANG (the extent depends upon the latitude) is simple but effective solar device. It keeps out summer sun, lets in winter sun.



the winter sunlight in. Inside would be thick adobe-like walls and heavy floors to store the heat, and heavy curtains to prevent it from escaping at night. The house would contain no special solar apparatus and yet the entire structure would be a natural collector and storage tank.

Another system might use a collector called a Trombe wall. This is a thick black wall placed directly behind southern windows, with a narrow air gap between wall and window. During the day the wall heats up. Cool air from inside rooms flows into the gap through a vent near the floor. The air is heated by the wall, rises and re-enters the room through a vent near the ceiling. And at night, the wall itself would give off heat stored up during the daytime.

Another clever passive system uses a "waterbed" in the roof. An insulated roof panel is either lifted or slid back during the day to let the sun heat a small roof pond or several water bags. At night the panel is closed and stored-up heat in the water radiates into the house.

active systems

One active system is usually distinguished from another by the type of collector it uses. The *flat plate* collector is the traditional kind—a copper, aluminum or steel plate, coated with glass or plastic. Water or air flows through small pipes that run through the plate. Another type is the *open* flat plate, or *trickle-down* collector. It was invented by an attorney, Harry Thomason, who came upon the idea during a rainstorm. Upon taking shelter under a shed with a tin roof, he noticed that the runoff was hot. So he made a collector of black corrugated metal with a pipe at the top. Water flows out of a series of holes in the pipe and trickles down the face of the collector, where it is heated. The water then flows into a gutter that transports it to a storage tank. The trickle-down is cheaper than a flat plate collector, but less efficient.

Another type is the *focusing concentrator,* which uses a lens or a reflector to intensify the sun's rays. Some of these actually track the sun across the sky. Concentrators are efficient, though bulky and expensive.

what about solar water heating?

Solar water heaters are simple in operation and are already being used by the millions in Australia, Israel, Japan and California. They make perhaps even more sense than solar space heating because hot water needs remain fairly constant the year around. That means the summer sun is just as useful to you as the winter sun.

A solar water heater uses a fluid-type collector (but tap water is not heated directly through the collector). Hot fluid from the collector runs through a coil in a tank. This heats water in the tank, which in turn heats a second coil through which the actual tap waters runs and is heated for use. Such systems can easily be combined with an existing water heater for backup purposes.

is solar heating worth it?

That's a tough question. As mentioned earlier, only homeowners in the Northwest—in a rainy pocket of land around Seattle, WA,—should write off solar energy with no further thought. Everyone else must consider a long series of complex factors, including present heating needs, your area's average solar radiation, whether you can save enough in fuel costs to justify the initial expense of a solar system, how much a solar system will add to your home's market value and whether your state offers tax incentives for going solar.

Figuring all the angles can get very tricky. For example, you'd think Nashville, TN, would get more solar radiation per year than Portland, ME,—and it does. But Portland gets more radiation in the winter, when it counts.

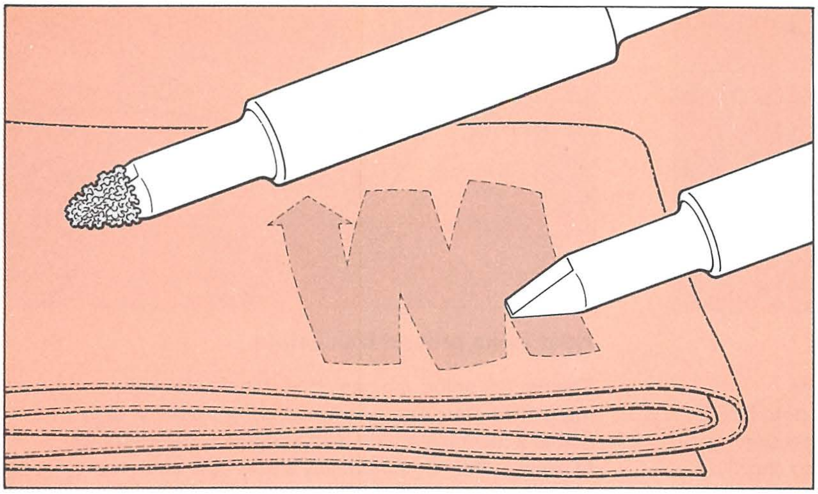
Or let's say you live in northern California in an area with only modest sunshine. Solar heat may still be worth the initial cost considering that state's liberal tax incentives.

The ultimate test is to figure out how much you would save in conventional fuel per year and then calculate how many years it would take before these utility savings equal the cost of the solar system. The average payback period is somewhere around ten years, after which a homeowner's solar heat becomes virtually free. But this figure varies wildly. In a sunny area with expensive electric heat, the payback period could be as little as three years. Or as long as 45 years in a rainy area with cheap gas heat!

an easy solution

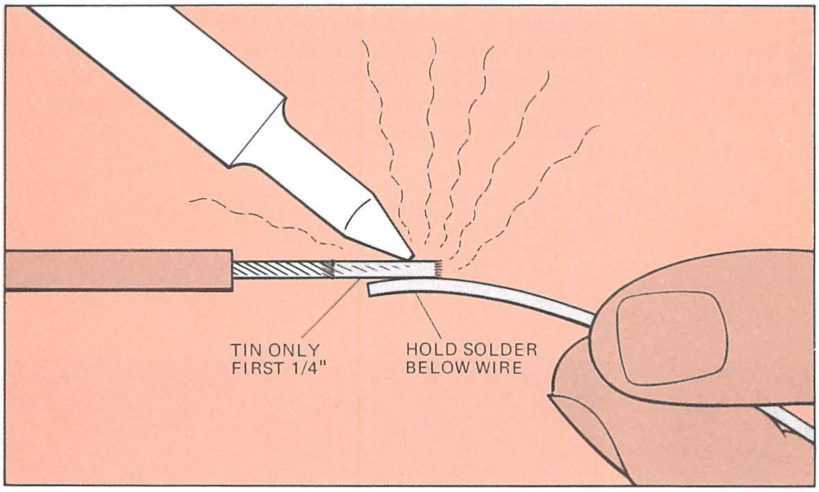
The National Solar Heating and Cooling Center operates a toll-free number you can call as this is written, to find out whether your home is ripe for solar heat or for other solar energy information. Dial (800) 523-2929; in Pennsylvania, call (800) 462-4983. The Center can also send you a list of solar builders and architects in your area and tell you about existing or pending solar legislation.

How to solder wiring



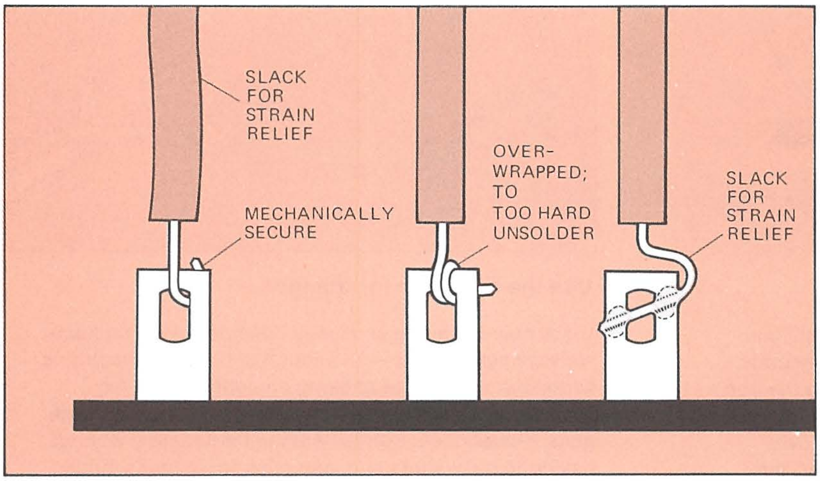
Keep your iron clean

A dirty iron won't transfer its heat to the joint efficiently. For best results, "tin" your iron's tip with a thin, shiny coating of solder before using it. After every few joints, clean the tip with a damp cloth or sponge—more often, if it acquires a dirty, dark or charred look, like the one shown at the far left. After cleaning, if the tip has lost its shiny appearance, re-tin it with another thin coat of solder. When the job is finished, clean and re-tin your iron again before you put it away



Tin wires carefully

Tinning any wire with a thin coat of solder makes it easier to solder to a joint. Tinning stranded wires also helps hold the strands together at the tip. Hold the solder below the wire so it will soak in, not drip on, and remove it and the iron once the solder has soaked into the first ¼ inch of the wire. Don't tin the remaining wire—it could become brittle and the joint break if wires are flexed or pulled. When soldering shielded cable, be careful not to melt the insulation by applying too much heat

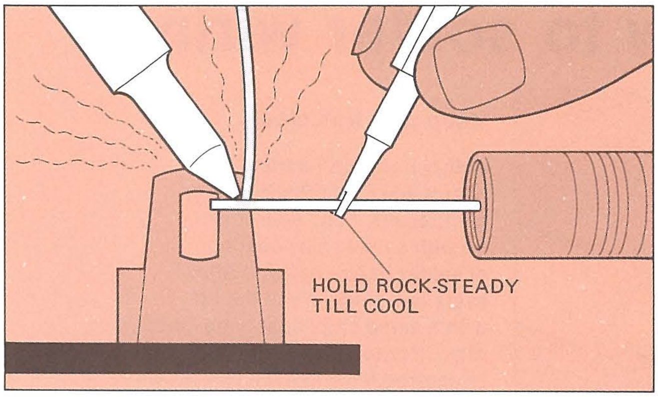


Make solid connections

Before soldering, wires should be bent to form mechanically secure connections (far left) that can stay in place even without solder; the solder's job is to maintain good electrical contact, not to glue wires in place. Leave some slack in the wire too, to prevent strain on the connection. Too complex a wrap (center) makes it harder to unsolder the wire for servicing. But a solder-only connection, with no wrapping, will usually yield a "cold-solder" joint

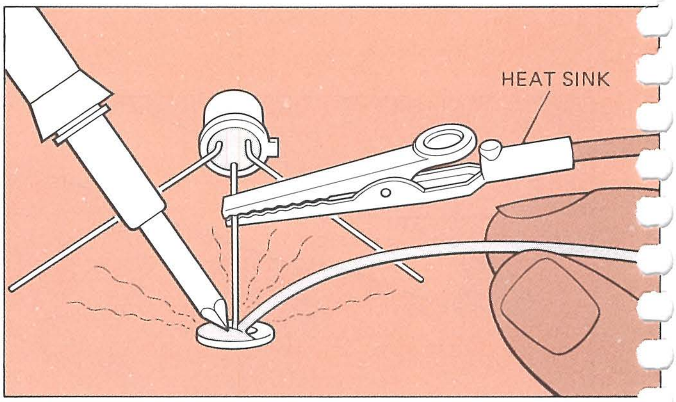
SEE ALSO

Doorbells . . . Electrical wiring . . . Electronics . . . Testers, continuity . . . Transistors . . . Wiring, electrical



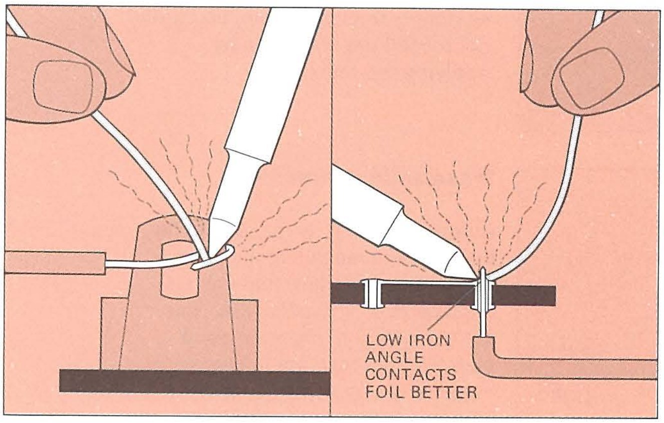
Keep wires stationary while cooling

Wires that move while the solder cools cause unreliable "cold-solder" joints. If you can't hold the wires in place with a good mechanical connection (as shown above, where a component lead is too short), hold them in place with soldering aids or other tools until the joint is cool. Brace your hands if necessary, to prevent shaking. Don't try to hold wires in place with the soldering iron—they'll spring up again as soon as you take the iron away. Soldering aids, of metal that solder doesn't stick to, also have many other uses



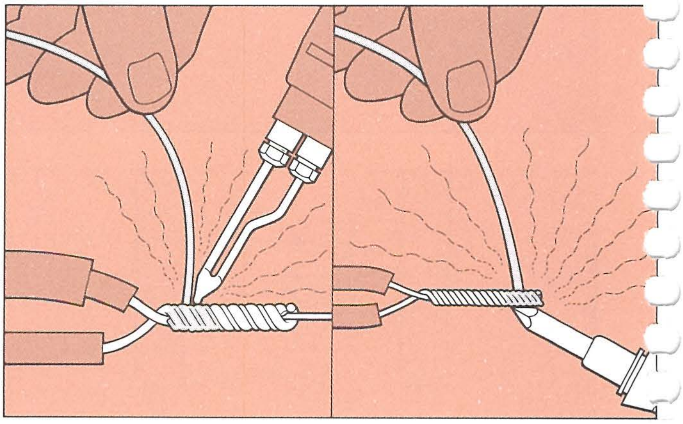
Heat sinks protect transistors

The heat of soldering can cook transistors and integrated circuits. If you're not using sockets, clip a heat sink between the joint and the transistor body to prevent this. Commercially made heat sinks are good, but you can also make your own from an alligator clip with a stub of heavy copper wire attached; or cement some felt into the clip's jaws and moisten it before each use. With no heat sink, use the least-powerful iron that will bring the joint quickly to soldering temperature. Too-small irons will cook more transistors than you'd think



Heat the joint first, then solder

Don't just melt the solder and drip it onto the joint. First, heat the joint with the iron for a few seconds, then move the solder into contact with both the iron tip and all the parts or wires to be soldered. When the joint is hot enough, the solder will flow over and into it, wetting it evenly, filling in spaces, and cooling to a smooth, silvery sheen. If the joint takes more than three or four seconds to heat, though, you're using too small an iron for that job

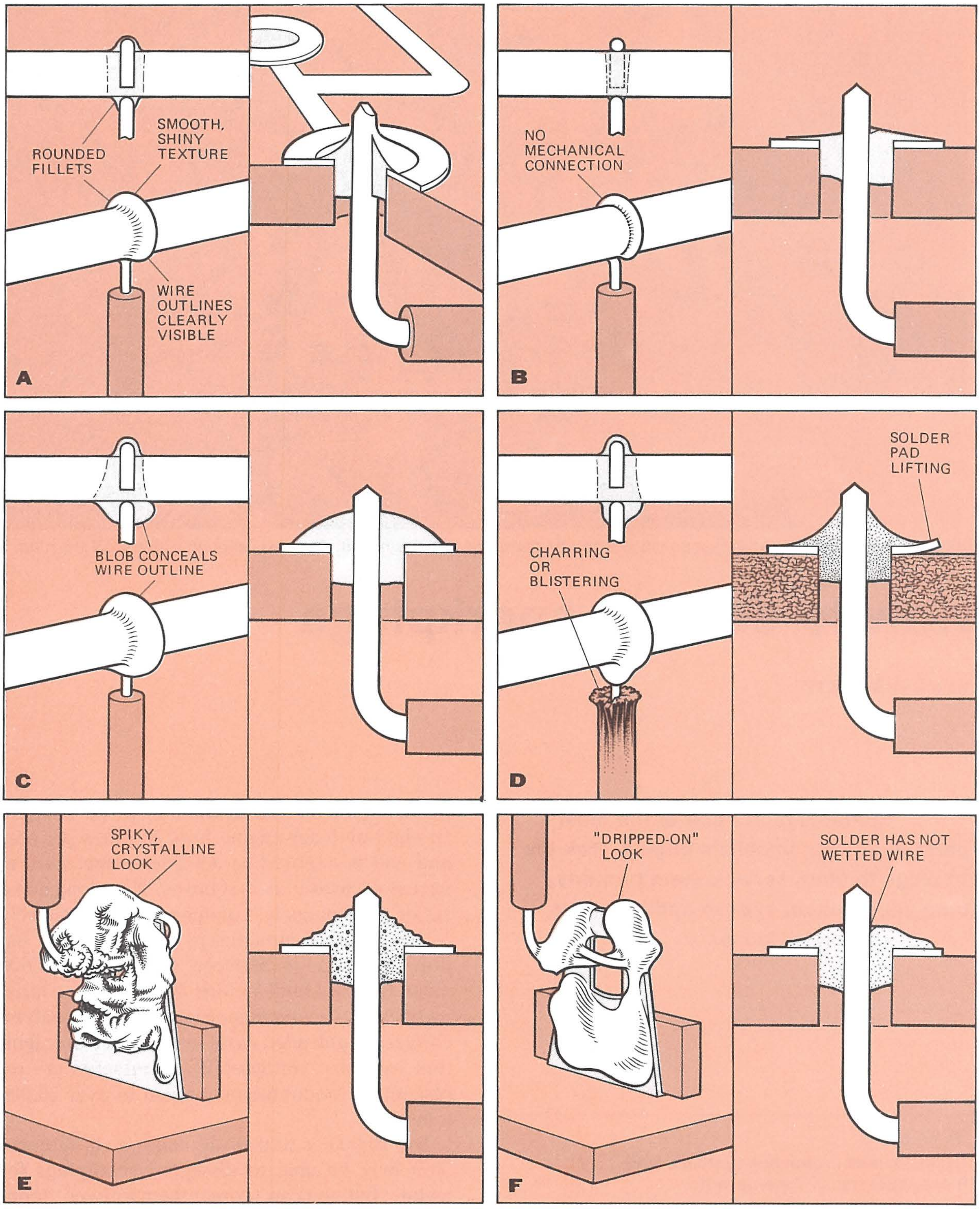


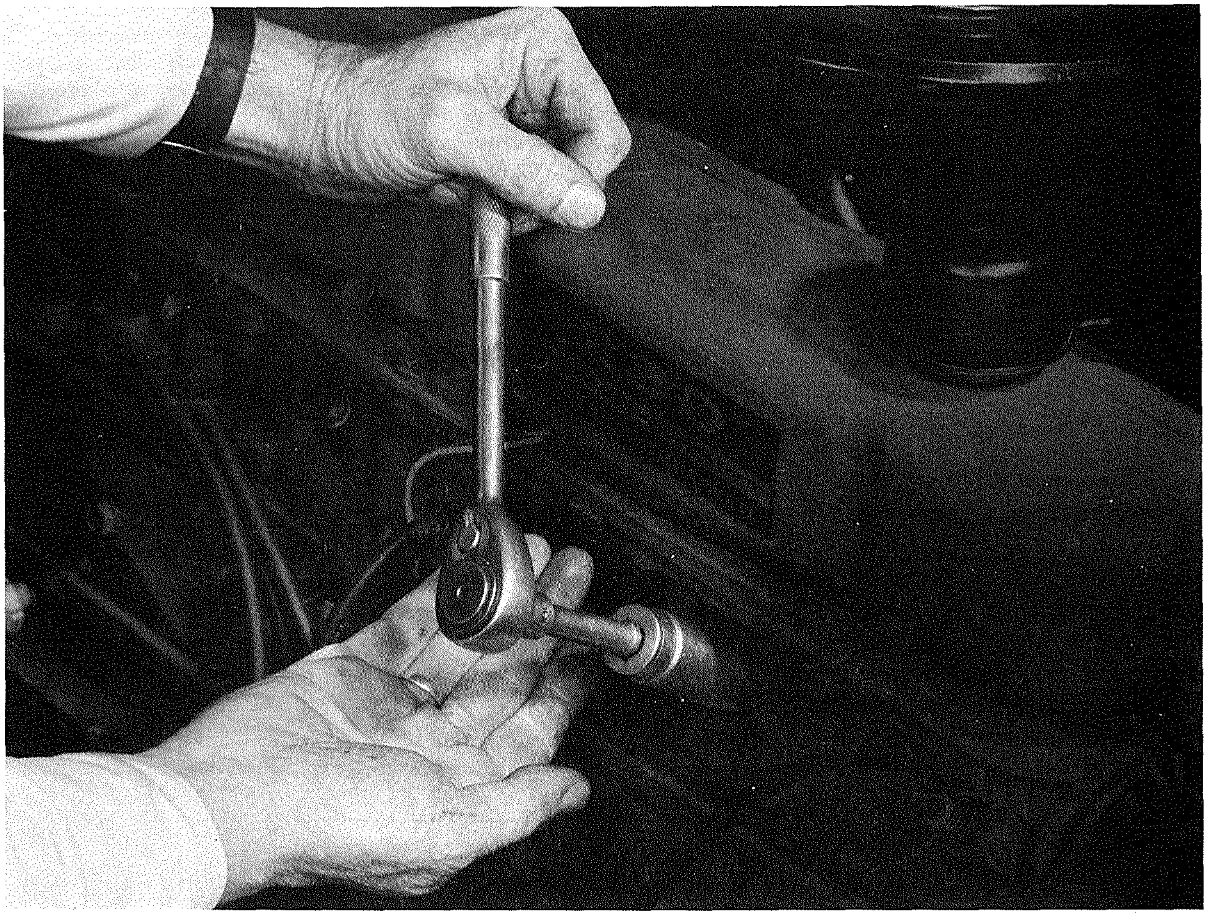
Use the right iron for the job

Electronic soldering is usually done best with medium-wattage pencil irons—hot enough to heat fine electronic wires quickly without cooking components. Heavy household wiring jobs are best done with high-wattage guns, powerful enough to heat the joint rapidly without having to bake wires and insulation for minutes; guns, which cool off between joints, are also handier than continuous-heating irons in the awkward places typical of house-wiring and other electrical situations

How to tell good solder joints from bad ones

Good solder joints (A) are smooth and shiny, with the outlines of all wires and contacts clearly visible, but with rounded fillets of solder filling in the gaps and corners where wires meet. Insufficient solder (B) leaves no fillets and may not maintain a reliable connection. Too much solder (C) covers a connection with big blobs (which sometimes cause short-circuit bridges between conductors on circuit boards); there may be a good joint underneath, but you can't see it to tell. Overheating (D) chars wire insulation and may lift solder pads from circuit boards or harm delicate components. Cold solder joints may have a jagged, crystalline look (E), a dripped-on, blobby appearance not conformant to outlines of the joint (F), or merely a hazy, milky sheen (not shown)





USE CORRECT-SIZE deep socket so plugs won't be damaged when removed. Keep axis aligned with that of the plug.

How to service sparkplugs

By MORT SCHULTZ

Sparkplugs are one of the most critical parts of any automobile's engine. Pick the right plugs to start, service them properly, tune your ignition system and the plugs will last a lot longer

SEE ALSO

Batteries, auto . . . Ignition systems, auto . . . Pulse checkers . . . Tune-up, auto

▨ THE ELECTRODE END of a sparkplug in an eight-cylinder engine fires 20 times per second and is exposed to a flame temperature in excess of 3000°F as fuel burns. How long can a set of sparkplugs last under these conditions?

Sparkplug manufacturers tell us that the national average is between 10,000 and 20,000 miles for cars built before 1975. More surprisingly, with the advent in that year of the catalytic converter, unleaded gasoline and electronic ignition systems, automobile manufacturers' replacement requirements jumped to over 20,000 miles.

But 10,000 or 20,000—it makes no difference. You may be able to disregard sparkplugs for awhile, but you can't forget them forever. Sooner or later, neglected sparkplugs are going to haunt you.

The most common "haunt" that bugs engines needing new sparkplugs is misfiring, which is failure by one or more sparkplugs to ignite the fuel charge in a cylinder or cylinders. The result is an engine that acts as if it has the willy-nillys, as well as an engine that gobbles inordinate amounts of precious gasoline.

There are three steps that you should take to keep sparkplugs (and your engine) happy for their full intended life, whether that tenure is 10,000 or 20,000, or more miles. These steps are:

1. Picking the right sparkplug for your engine. More than one kind will fit.

2. Servicing sparkplugs midway through their anticipated life. This means that if your car's manufacturer recommends you replace sparkplugs at 12,000 miles, for example, that you service them at 6000 miles. And if replacement is called for at 22,500 miles, that you service plugs at a little past 11,000 miles. Consult your car owner's manual to determine replacement recommendations.

3. Making sure other ignition system components are operating at peak efficiency. These components have one major responsibility, and that is to produce current that plugs need to make spark.

picking the right sparkplug

The sparkplug recommended by the manufacturer of your car is designed to accommodate a more or less equal amount of idling, slow-speed and high-speed operation. It's not always the one that's needed. The right sparkplug is one that best meets the thermal conditions which are present most often inside the cylinder head.

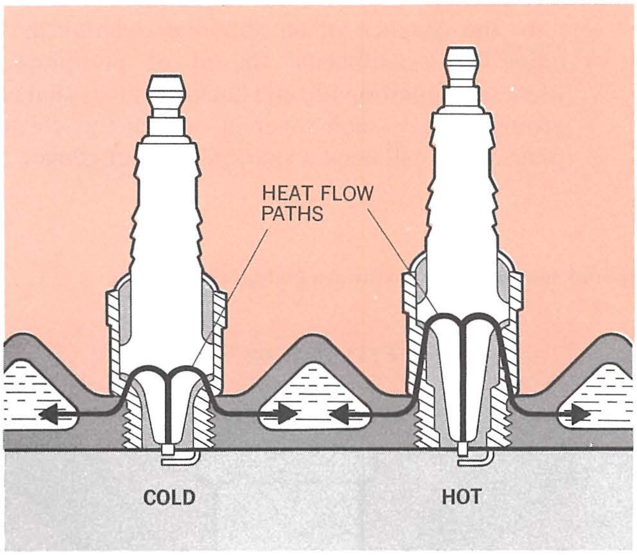
If a plug can't get rid of heat fast enough, it can begin to glow and cause preignition—igniting fuel mixture before spark occurs—which can ruin an engine.

Conversely, if a plug doesn't heat up to a temperature that's sufficient to burn away deposits which form on the tip of its insulator, these deposits will eventually cause the plug to short circuit. The engine will then misfire.

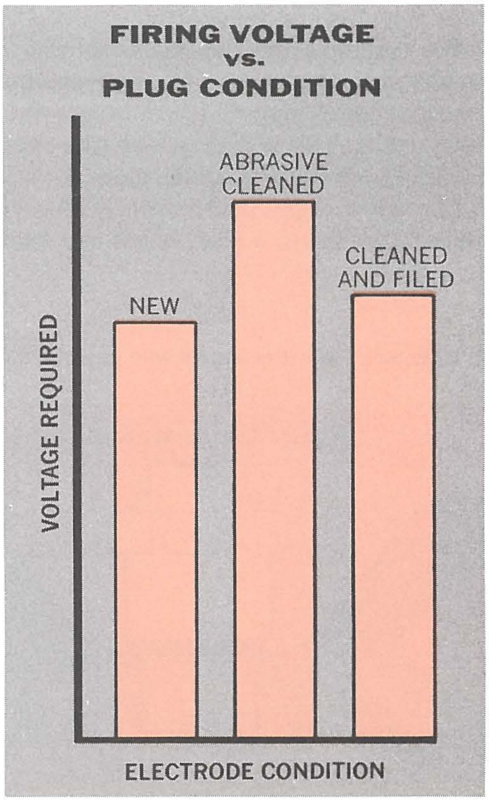
Thus, a plug's heat range as determined by the length of its lower insulator is a major consideration. The longer this insulator, the hotter the temperature at which the plug will operate; the shorter the insulator, the cooler the temperature at which the plug will operate.

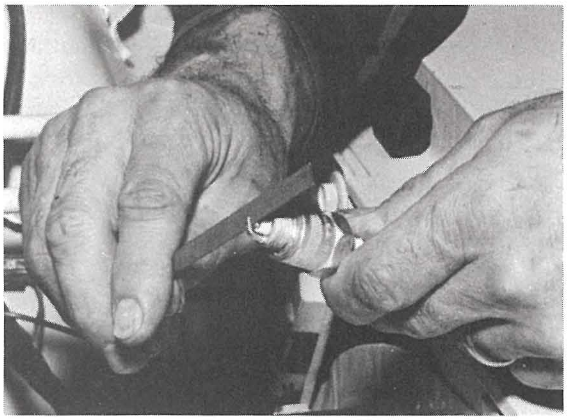
Each size of sparkplug is manufactured in a number of heat ranges from cold to hot. A cold plug gets rid of heat rapidly. It won't overheat and cause preignition when temperature in the combustion chamber is relatively high—that is, when the engine is under load as, for example,

HEAT FLOW—HOT PLUG vs. COLD

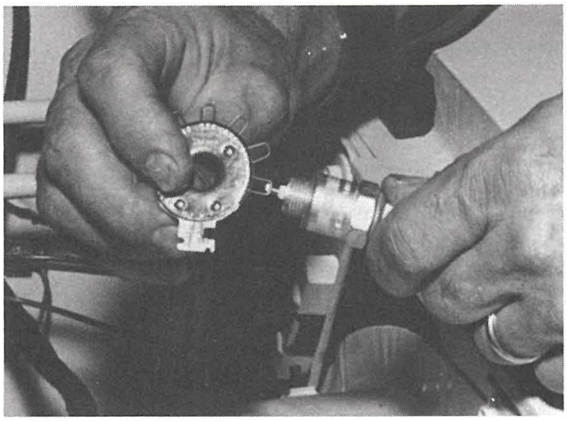


"COLD" SPARKPLUG has a short insulator nose, expels heat rapidly; "hot" plug has a long nose and holds the heat longer. Abrasive cleaning removes deposits on insulator but causes rounding of electrode edges, increasing voltage requirements.





FILE ELECTRODES until clean, bright and square. You can buy an ignition file at any auto supply store.



IF SIDE electrode must be bent to gap plug, use gapping gauge bending tool since pliers may mar the plug.

during high-speed operation or when pulling a trailer.

On the other hand, a hot plug gets rid of heat slowly and is used to avoid fouling when combustion chamber temperature is relatively low, as it would be under stop-and-go city driving.

How do you determine which plug your engine actually needs? Start with the plug that's recommended. Check your owner's manual.

The recommended plug also tells you the size plug your engine needs. Correct size is the thread and reach that match the dimensional requirements of the cylinder head. It's given in code, but that's not important.

For example, if the manufacturer recommends a Champion UJ-12Y, it means that your engine requires plugs having a 14-mm thread and ⅜-in. reach. This will always be true even if you switch to a hotter or colder plug.

The auto supply dealer from whom you buy plugs will refer to a size, reach and heat-range chart when you tell him. "I need the next colder plug from UJ-12Y"—which happens to be UJ-10Y.

After operating with the recommended plugs for several days, remove some from the engine and examine their insulator tips. If they are gray or light tan with a light chalky deposit, the plugs are okay for your engine.

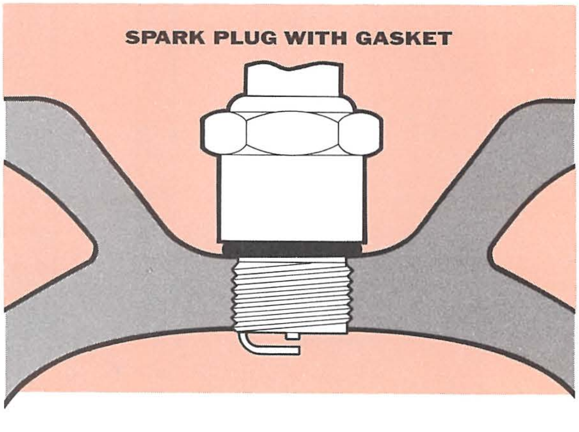
However, if tips are sooty or oily, a hotter plug is called for. If tips are ghostly white, try a colder plug.

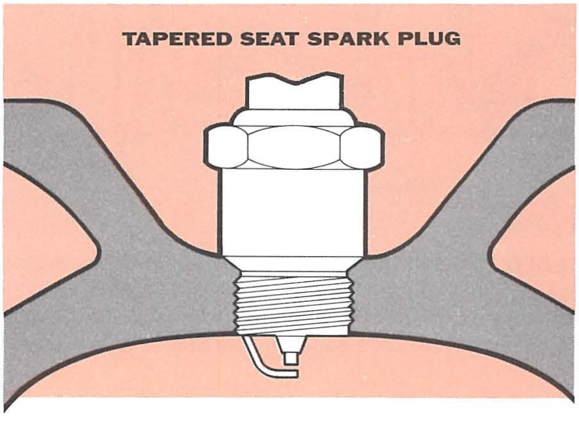
When going from hotter to colder, or vice versa, move up or down the scale one heat range at a time.

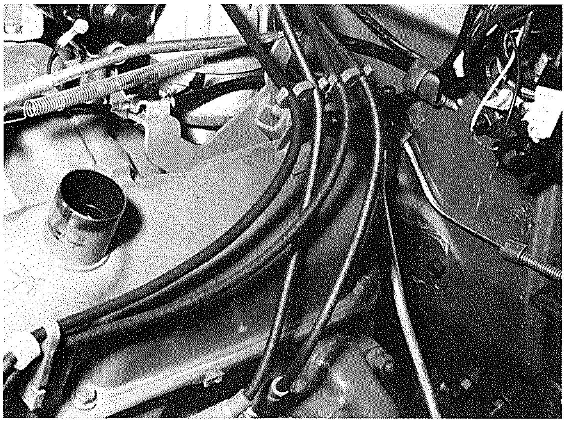
servicing sparkplugs

In the absence of an abrasive cleaning machine that "sandblasts" the tips of sparkplugs, use a small ignition file and hacksaw blade that is ground to a ⅛-inch taper at one end to clean plugs. You will need a sparkplug feeler gauge.

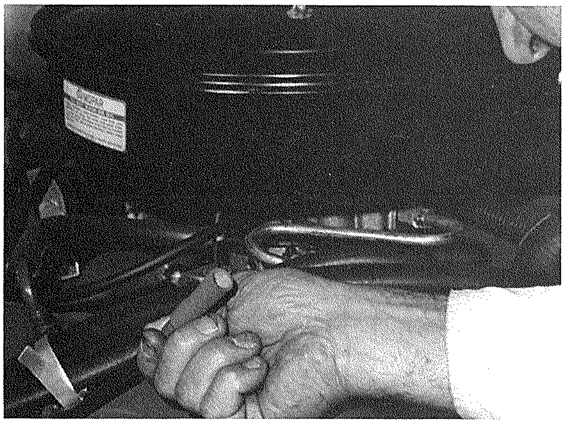
IF NEW plugs aren't equipped with gaskets, they have tapered seats and should always be tightened firmly.







DON'T TRY to be neat and run wires parallel; keep crisscrossed as shown here to prevent crossfire.



USABLE PLUGS may be blamed for flashover (see text) actually caused by dried-out, cracked boots.

Start servicing plugs by removing them from the engine in the proper manner:

1. Mark each ignition wire so it can be replaced from where it was taken. One way is to use a white felt marker to place spots on each wire. One spot, for example, signifies the first wire, two spots signify the second wire, and so forth. Failing to put cables in their proper places will result in a foul up of the engine firing order, which will cause disastrous engine damage.
2. Grasp the boot covering the sparkplug. Rotate and pull it away from the plug. Under no circumstances grab or violently pull sparkplug cables. You will ruin them.
3. Blow loose dirt particles out of sparkplug ports. If a compressed air supply is not available, use an ear syringe.
4. Attach either a 13/16-inch or 5/8-inch socket to the plug, depending upon the size of the plug. Attach a ratchet to the socket and turn the plug counterclockwise. Loosen each sparkplug one turn only.

Note: If you are removing sparkplugs from an engine that has an aluminum head, the engine should be cold. Engine heat can cause plugs to seize in an aluminum head.

5. Reattach sparkplug cables when all plugs have been loosened. Start the engine. Run it at a little above slow idle speed for a few seconds. The slight compression leak which will be produced will blow away carbon particles that may have come loose when plugs were loosened. These particles could otherwise fall inside the cylinder as you remove the plugs and cause engine damage.
6. Turn off the engine and again remove cables from the sparkplugs.
7. Remove the sparkplugs and insert each in a sparkplug tray that is numbered to coincide with the number of the cylinder from which you take the plug. You want to be able to identify sparkplugs, so you can pinpoint defects that might be revealed by the plug to the particular cylinder. Furthermore, each sparkplug should be returned to the cylinder from which you take it.

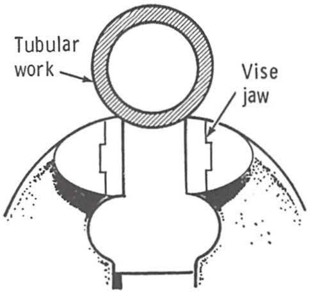
Now, inspect the plug's electrode end to determine if any unusual engine condition exists. If plugs (or a plug) are coated with deposits, badly eroded, or have a broken insulator nose, a mechanical condition, such as overadvanced timing, overheating, or a leaking cylinder, exists.

If the tips of plugs are coated with oil, it points to either a defect in the cylinder such as worn valve seals, or to the use of plugs that aren't hot enough. If the tips of plugs are ghostly white, you probably need a colder spark plug.

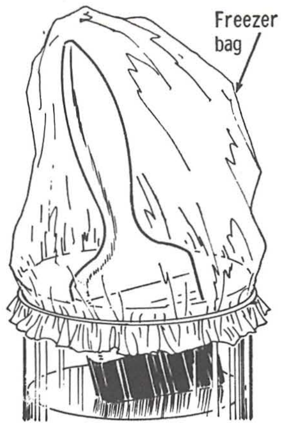
After cleaning, file the electrodes vigorously to obtain sharp, bright edges. Reset the electrode gap to specification by bending the side electrode only.

The sparkplug electrode gap for most engines having conventional ignition systems is .030 or .035 inch. The sparkplug electrode gap for engines with electronic ignition systems varies from .040 to .080 inch. You must check the service manual or the tuneup decal in the car's engine compartment for the correct gap.

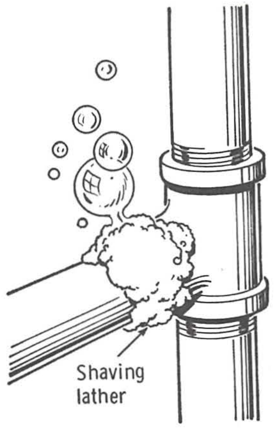
You should use a torque wrench to install sparkplugs to the specification given in the manual by the manufacturer. However, if a torque wrench is not available, seat sparkplugs finger-tight. If plugs are equipped with gaskets, tighten them another one-half turn with the socket to make certain they provide a gas-tight seal.



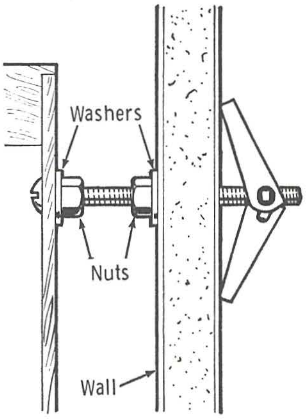
WHEN hacksawing metal tubing, don't risk crushing it out of round by clamping it in a vise. Instead, open the vise just enough so that the jaws act as a V-block. Then you can hold the tubing in the slot and rotate it slowly as the saw cuts through it.



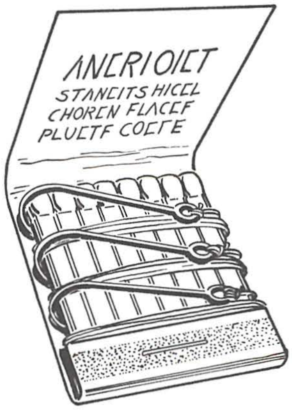
ONE SIMPLE WAY to keep a paintbrush soft overnight without cleaning it is to stand it in a jar containing a small amount of thinner. Slip a polyethylene freezer bag over the top and secure it with a rubber band to seal in all of the fumes from the thinner.



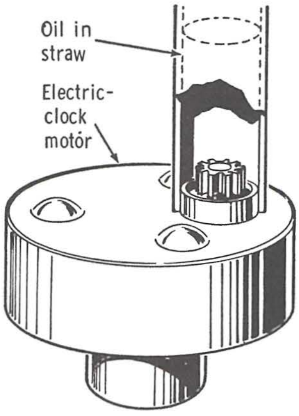
MOST PLUMBERS still use a bubbly soap solution to test connections in a home gas system. However, a much more modern material for the job is shaving cream packaged in aerosol cans. It's dense, long-lasting and excellent for use in hard-to-reach spots.



TALL CABINETS or bookcases have a tendency to wobble in cases where the baseboard prevents them from being set flush against the wall. If the wall is hollow, you can easily anchor them with toggle bolts through the back panels.



CARRYING FISHHOOKS loose in your pocket is normally not advisable. To make it safe, use a book of matches. Just slip the points under the matches and wrap the leaders around to hold them in place; then close the matchbook cover.



IF THE MOTOR in your electric clock becomes noisy, here's an easy way to oil it. Slip a straw over the gear shaft, pour a little light oil into it, then heat the motor enough so that air bubbles escape. Let it cool and oil will enter around the shaft.

How to install car stereo speakers

By EUGENE WALTERS

There's no special trick to making your car into a total sound stereo system. The speakers can be located on the rear window deck or the front door panels and hooked into your radio or tape deck

YOU DON'T HAVE to have a pro install your car speakers to get a professional-looking job like the one above. But it pays to do it like the pros do.

First, decide where you want your speakers. Rear-deck speakers are often easiest to install, since many U.S. cars already have the necessary holes. But front mounts—in the doors or front kick panels—give you the best stereo effect in the front seat. And that's the seat most likely to be occupied.

Probably the hardest part of mounting speakers in a door is finding a spot where they won't interfere with structural members or the window mechanism and at the same time won't be placed where the seats will swallow up their sound. Pros (like the ones at Wally's Tape City in New York, where the pictures on following pages were taken) know these spots, but you'll have to find them. Loosen the door trim panel, and check out possible speaker sites as you raise and lower the window. Then measure carefully and cut your hole. Use a sabre saw or hacksaw, or drill a circular pattern of holes and saw from one hole to the next. But don't use a power drill or saw on carpet-covered doors—the carpet may tear or run.

To run the speaker wires, remove the inner kick-plate trim (just in front of the door) and drill holes opposite each other in the door edge and door pillar. Line the holes with grommets, so their edges won't cut the insulation. Run wire through the holes to the speakers, and solder them so they can't vibrate loose. Make sure the "hot" leads from each channel of your tape deck go to the same terminal on each speaker, or you'll lose bass response.

For rear-seat speakers, snake the wires unobtrusively through the car by tucking them under the edge of the carpet or floor mats. Where the wires pass the doors, run them under the door saddle (first removing the saddle to clear away gravel or debris that might cut the wires).

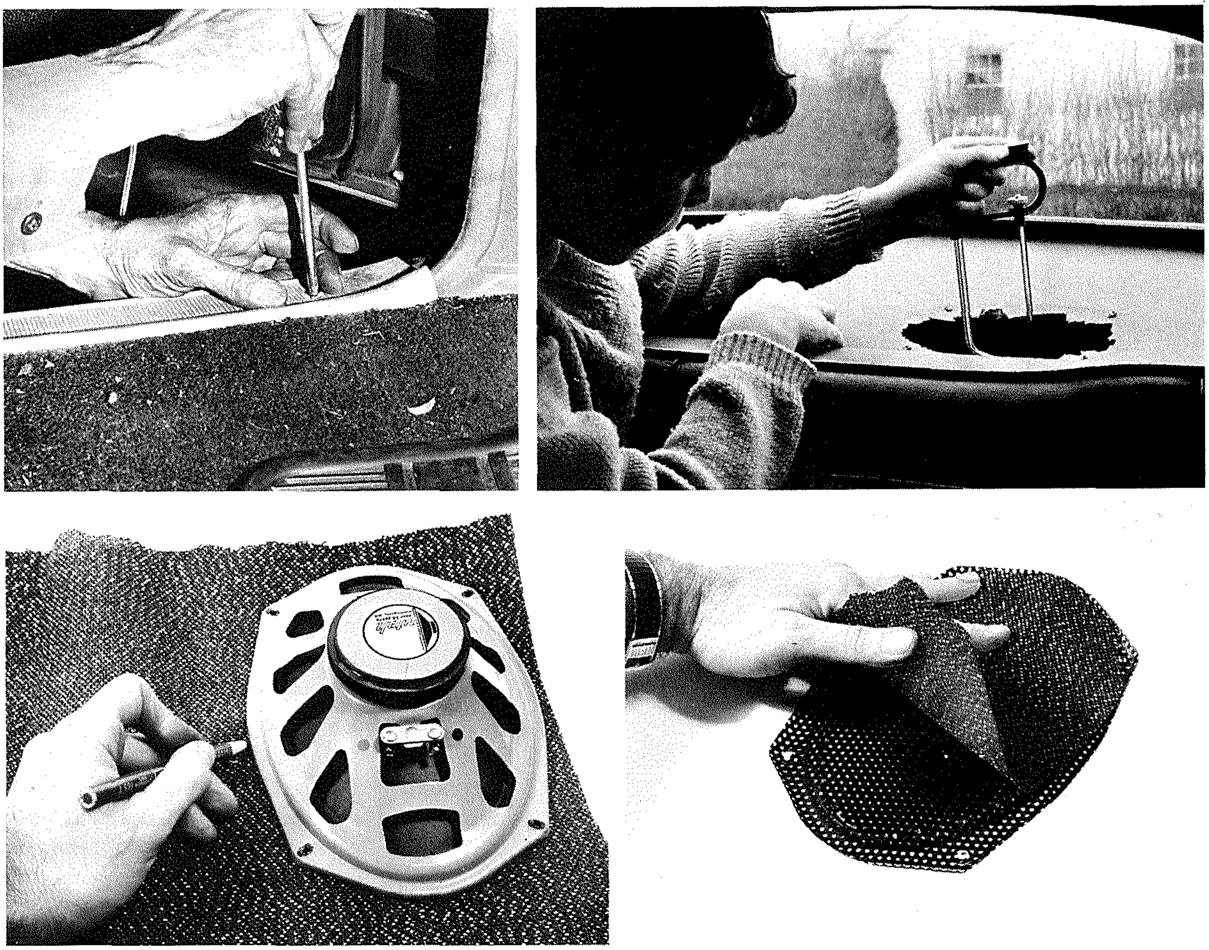
To get the wires into the trunk, you must usually remove the rear seat cushion, which is easy. But getting it locked back in again is usually a two-man job. The holes that pass the wire into the trunk should also be grommeted to prevent chafing; it's not a bad idea to caulk the space around the wires, too, against the possibility of exhaust-fume leaks.

Wedge-type, surface-mounting speakers are easiest to mount on the rear shelf, requiring only screw holes for attachment and a grommeted hole for the wire. If the wedge has an open bottom. cutting a larger hole under the speaker will give you better bass response, by letting the trunk act as a resonator.

But wedge speakers can obscure rear vision. and their plastic cases can warp in sunlight. So flush-mount speakers are usually preferred (and many wedges' grilles and speakers can be disassembled and flush-mounted, if you prefer).

Most American cars now have 6x9-inch speaker ovals cut in the metal frame under the rear shelf, often with the deck's fiber covering perforated to form a grille. If your car lacks these perforations, you'll have to cut the fiber. A sharp knife does the cleanest job, but the speaker grille should cover ragged saw-cut edges. If the metal

SEE ALSO
**Cassette recorders . . . Cassette tapes . . .
Electronics . . . Hi-fi centers . . . Stereo . . .
Tape recorders**



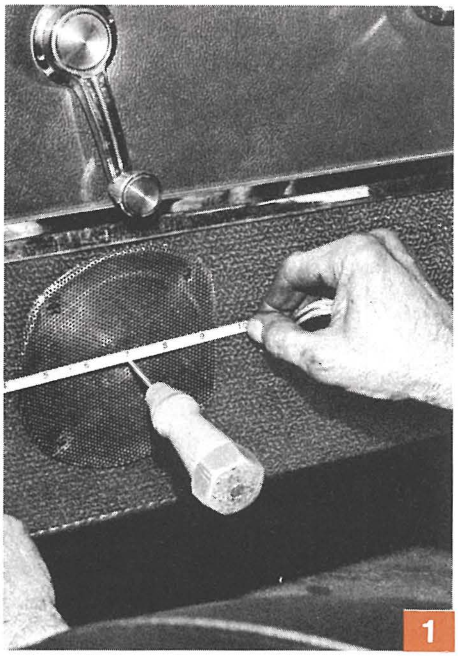
REAR-DECK SPEAKERS ARE EASY TO INSTALL

REAR DECK SPEAKERS' leads go past the doors most neatly if you unscrew the door saddle (upper left), clear out rough debris that could damage the wires, and run wire under the saddle. Rear-deck mounting is often eased by holes precut for 6x9-in. speakers. If you must cut your own hole, hacksaw work (upper right) can be reduced by drilling a series of holes and sawing between them. Slanting rear windows often prevent the use of a sabre saw from the top of the deck, but you can approach the deck from in the trunk below. Grille cloth can keep small holes from focusing sun on the speaker. Cut it to fit the speaker (lower left) and apply it under the grille (lower right). Avoid plastic grilles on the rear deck. The location is too hot and some housings can melt or warp if located there.

is not precut, you'll need a hacksaw or sabre saw. Window overhangs make sabre saws impossible to use from above the shelf on many cars, but if so, you can get in the trunk and cut upward from there. Speaker attachment holes can be poked through the fiber with an icepick; if you have to drill the metal yourself, drill from inside the trunk until the metal is holed, then finish with the icepick. Bolting the speakers in place is easiest if you have a helper in the trunk to hold the speaker nuts and lockwashers as you tighten the screws from above.

Rear-deck speaker grilles should be dark to avoid annoying reflections and preferably not be plastic, which can warp. But metal grilles' small holes (or those in some deck perforations) can focus the sun's rays like pinhole lenses, sometimes damaging speakers. Here's where an ounce of prevention (or an ounce of grille cloth) is worth lots of cure. Before attaching a metal grille. cover its underside with speaker grille cloth. Cut the cloth to fit the grille and tack it in place with beads of cement around the grille edge.

If you're wiring stereo speakers in both the front and rear of the car, use identical speakers mounted at identical heights for best sound balance. Add-on front-rear stereo balance controls may cause distortion in some installations, but they're cheap, so try them if you like. Four-channel tape decks (and some stereo ones) have built-in connections and balance controls for four speakers.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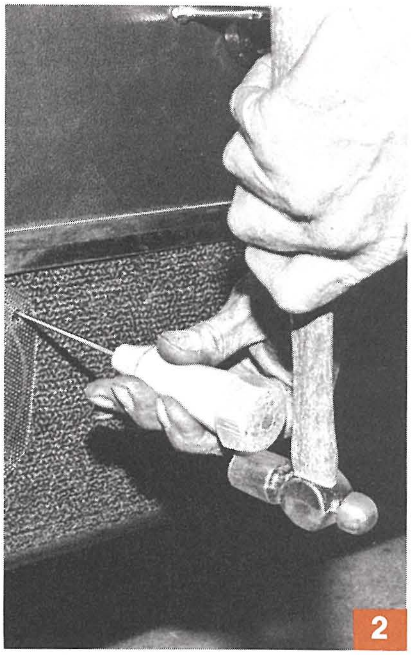
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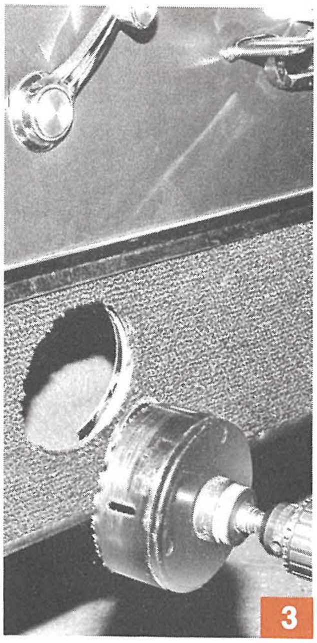
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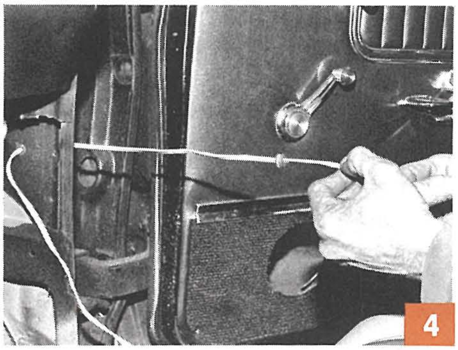
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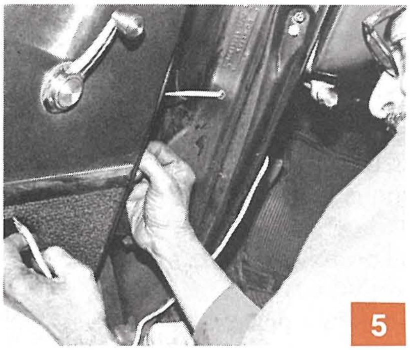
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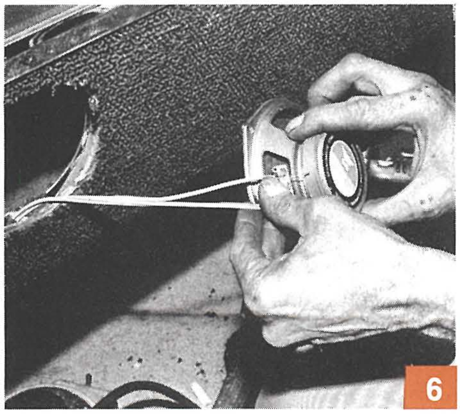
OPEN UP THE DOOR PANEL. IF YOU'VE NEVER DONE IT BEFORE, YOU'LL FIND IT'S EASY TO DO, AND HELPS YOU PINPOINT THE BEST SPEAKER LOCATION

AFTER OPENING THE inside door panel to find the best speaker location, measure the distance on the panel (1); mark, punch and drill mounting holes operating from the most reasonable working position you can find (2); then cut the speaker hole (3). Use care; carpeted door panels are often vulnerable to power tools. Now remove the car's inner kick-plate panel (4); drill the panel and door edge; and thread the wire (4 and 5). Grommets are a smart idea. Run leads to the speaker (6) and solder them, positive to the same post on each speaker. Position the speaker, align the holes (7), and mount the speaker and grille (8). Use self-tapping screws if the door is metal, speed nuts or washers and lockwashers if it's fiber. The grille shown here matches the car's interior, but a chrome grille such as the one shown on page 2849 is significantly more scuff resistant.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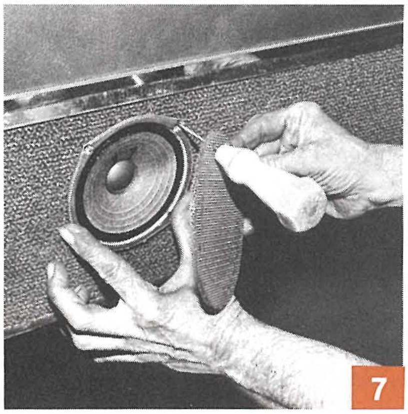
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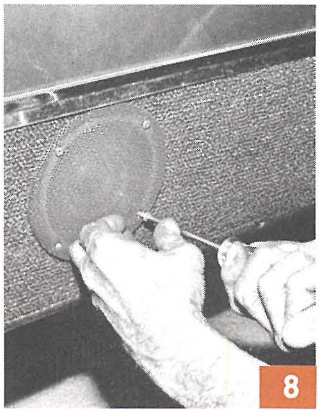

8

Troubleshooting speedometers and other instruments

By MORT SCHULTZ

▪ THE INSTRUMENTS in a car are delicate devices that are taken for granted until they begin acting up. Fortunately, they aren't complicated. Consider the speedometer, but don't confuse it with the odometer.

The speedometer is the part of the gauge that informs you how fast the car is moving. The odometer, which is combined in one gauge with the speedometer, tells you how many miles the car has traveled. If the speedometer isn't working, the odometer won't work either.

Luckily, the speedometer head is a reliable instrument that seldom breaks down. When it does, repair requires special tools and knowledge. If you determine, using the information in this article, that a malfunction is located in the speedometer head, price the cost of a new or rebuilt speedometer. You will probably find that it costs almost what repair would cost.

When speedometer failure takes place, the cause of the problem is almost always the speedometer cable. The cable is attached at one end to the speedometer head. At the other end, the cable is attached to the transmission or to one of the wheels.

Most cars use the transmission-shaft rotation method. The flexible speedometer cable is connected to a pinion gear on the transmission.

As the pinion is driven by the transmission output shaft, it drives the cable, which drives the speedometer head that registers speed. Also driven is the geared odometer, recording distance traveled. The speedometer cable is protected by an outer casing (housing), but the two parts—cable and casing—are separate.

A speedometer problem becomes apparent in one of four ways: a ticking or scraping noise is heard; the speed indicator, if it's a needle, moves and then hangs up; the speed indicator doesn't hold steady when car speed is steady; the speed indicator just doesn't work.

Speedometer noise is the most common problem and usually precedes complete failure. In other words, noise coming from speedometer probably means that the cable is in bad shape and will snap if you don't take action.

SEE ALSO

Autos, repair . . . Lubrication, auto . . .
Ramps, auto repair . . . Tune-up, auto

disconnecting the cable

There are two ways that speedometer cables are connected to the speedometer head. Many older model cars have a conventional coupling nut that you tighten and loosen with a pair of pliers. Most newer models have a quick-disconnect release that you press in. You then pull the cable from the speedometer head.

A problem you will have to face is how to get to the rear of the speedometer head so you can get at the cable-to-speedometer connection. The way varies from car to car, and in some cases from model to model of the same make and year.

With some cars, such as the 1977-78 Ford Motor Co. models, you can reach under the instrument panel and release the cable by pressing the quick-disconnect. This is the easiest type of cable disconnection to make, so try it first.

With other models, such as some 1977-78 Pontiacs equipped with airconditioning, you have to remove the lower airconditioner duct. And with still other cars, such as the 1977-78 Cadillac, you have to remove the instrument cluster.

If the coupling nut is tight so that it couldn't be the cause of noise, disconnect the cable from the speedometer head and slowly pull the cable out of its housing.

A cable that is run off the car's front wheel must first be detached from the wheel by removing the outer hub cap and pulling the cotter pin that attaches the cable to the inner hub. Loosen the nut at the speedometer head to pull the cable from place.

If the cable catches as you pull it from the housing, both the cable and housing are damaged. Replace both.

checking the cable

With cable out of the housing, check it for a bent tip (speedometer head end), kinks and whipping. If the cable tip is bent replace the cable.

Wipe the cable clean with a rag and lay it out straight on a flat surface. Roll it back and forth. If it doesn't roll smoothly, it is kinked and should be replaced.

Pick the cable up and take an end in each hand. Allow the cable to hang in a 9 to 12-inch loop. Twist it between your fingers. If it whips or jumps rather than turns smoothly, replace the cable.

The main reason for speedometer noise is a cable that needs lubrication. Most manufacturers call for lubrication on an as-needed basis—that is, when the cable becomes noisy, lubricate it. In lubricating a speedometer cable, remember that too much grease is as bad as too little. Excess lubricant can cause failure of the speedometer head.

To lubricate a cable, apply a very thin film of speedometer cable lubricant or a lubricant such as Lubriplate that is cold-resistant and waterproof. Then, wipe off excess by running the entire cable length through your fingers.

Caution: Do not lubricate the cable tip. Grease here will damage the speedometer head.

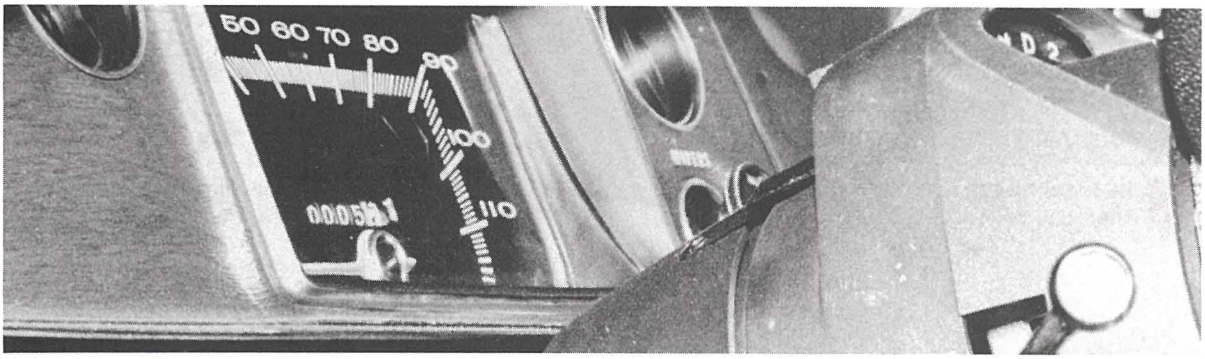
Before putting the cable back into its housing, conduct another easy test to determine if the cause of noise is the drive gear in the speedometer head. Get a short piece of cable, insert it into the head where the cable connects, and rotate it. If the head drags or makes noise, that's where the trouble is. Replace or repair the head.

When reinstalling the cable, feed it through the housing slowly and carefully so it doesn't kink. When the cable is just about seated, twist it slightly to engage its far end firmly into the seat in the pinion gear at the transmission.

With a cable that works off the wheel, make sure the cable goes through the hole in the hub and that the cotter pin is inserted.

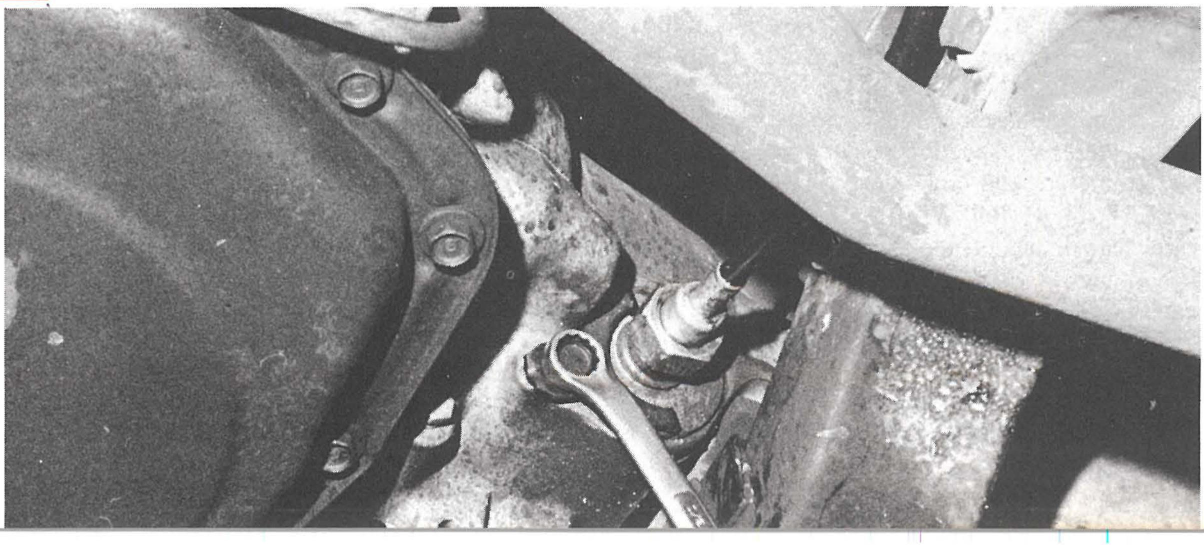
The reasons why a speed indicator will flutter are a kinked cable and housing, which are checked as you pull the cable from the housing, and a damaged speedometer cable. If kinking isn't the problem, replace the cable.

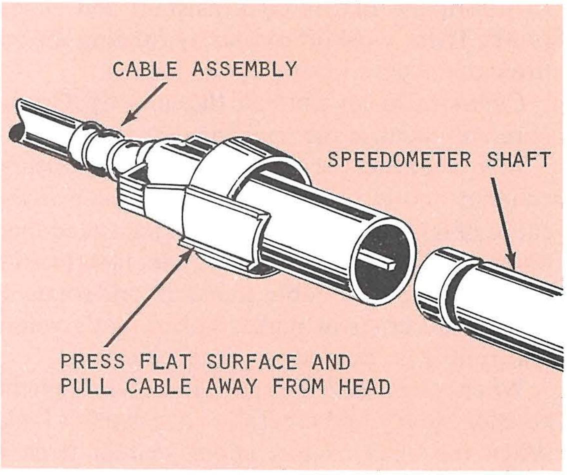
A speedometer that doesn't work at all is the result of a cable that has worked loose from the head (check the coupling) or, more likely, by a



1 **IF THE SPEEDOMETER** isn't working, the odometer won't work either. They work as a team.

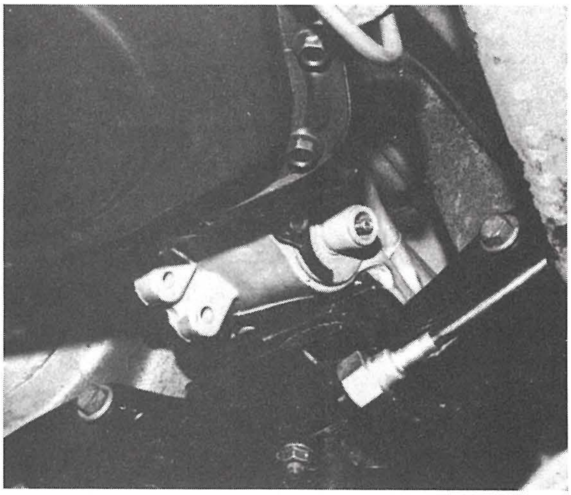
2 **IN MOST CARS** the speedometer cable is connected to a pinion gear on the transmission.



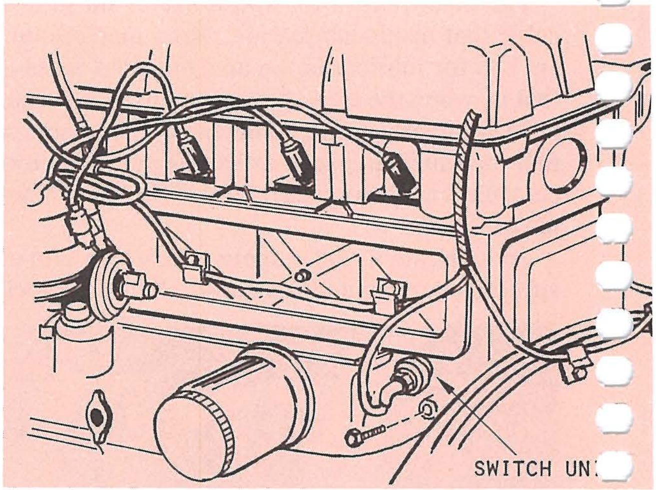


3 **MOST NEW MODELS** have a quick-disconnect coupling between cable and speedometer head.

4 **IN SOME CARS** you just reach under the instrument panel and release the cable.



6 **DETACH CABLE HOUSING** from pinion gear. Then pull the broken cable from the housing.



7 **SENDING UNIT** for the oil-pressure indicator is located in the crankcase or the oil filter.

cable that has snapped. To get a broken cable out of the housing, you have to disconnect it at the speedometer head and pull one end of it out.

Now, get beneath the car and detach the cable housing from the pinion gear. The other end of the broken cable can now be pulled from the cable housing.

Reconnect the cable housing to the pinion, and install a new speedometer cable from the speedometer head end as explained before.

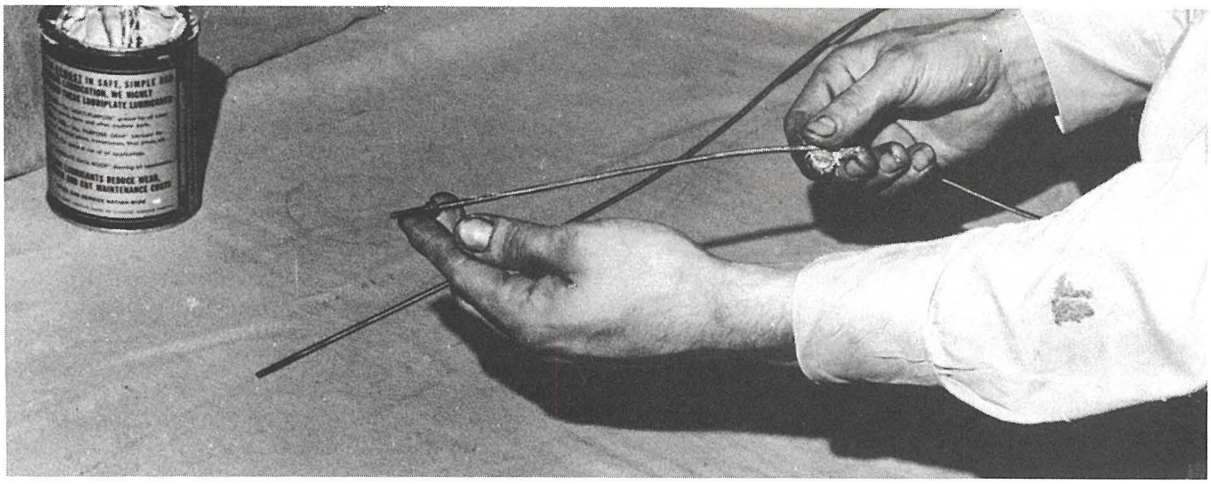
How can you tell if your speedometer is accurate? Run distance-time checks or compare your speedometer with a speedometer on a friend's car that is known to be accurate.

Speedometers will show an incorrect reading if the car is equipped with oversize or undersize tires or if the pinion in the transmission is not the correct one. Rear axle gear ratio and tire size determine pinion gear size.

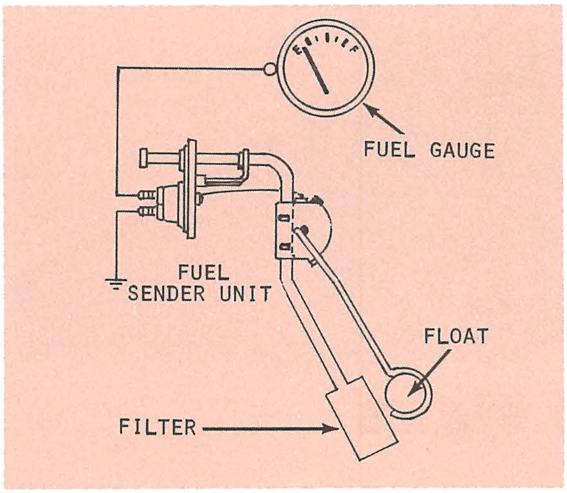
Consult the speedometer pinion chart provided in the car's service manual. You can buy the correct part from the parts department of a new car dealer who sells your make of car. Installing the pinion is easy enough.

Detach the speedometer cable from the pinion and remove the retainer that holds the pinion in the transmission. Be prepared to catch transmission fluid as you pull the pinion from place.

Now, simply insert the new gear, making sure it engages firmly and fully in the transmission. Reconnect retainer and hook up the speedometer cable housing.



5 **APPLY LUBRICANT** sparingly to cable, then wipe off excess by running cable through fingers.



8 **FUEL-LEVEL FLOAT** is connected to the fuel-sending switch unit on the engine.

rundown on other instruments

The instruments we are concerned with here are the ones that all cars have: oil-pressure, water-temperature, and fuel-level indicators.

Each instrument consists basically of a gauge or warning light, sending unit (switch) and a wire between the two. Instruments are extremely reliable, but if one fails, the fault most often lies with the sending unit.

In the case of the oil-pressure indicator, the sending unit is located in the crankcase or oil filter. In the case of the water-temperature indicator, the sending unit is located in the cylinder head. Both sending units may be replaced just by unscrewing them.

The first thing to do when a problem arises with either of these is to pull the wire lead from the sending unit and wipe the end of the sending unit and wire clean. Oil and grease that get on the switch will hamper its function. The next step is to replace the sending unit.

If this fails to resolve the malfunction, the gauge or warning light bulb should be replaced next. This involves releasing the instrument cluster. You will know for certain that the warning light bulb is bad if it fails to light up when the ignition key is turned on before the engine is started.

The last possible reason for a malfunction of the oil-pressure and water-temperature indicators is a weak wire between the sending unit and instrument. The wire should be secured. If this fails to solve the problem, the wire should be replaced.

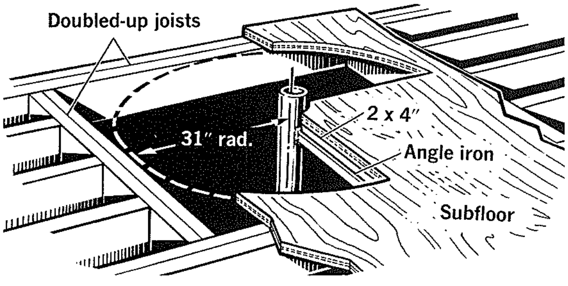
Note: Some models use a constant voltage regulator to control the voltage to instruments. If all instruments go awry at one time, chances are almost 100 percent that the constant voltage regulator should be replaced.

A typical fuel-level indicator uses a float in the fuel tank which rises and falls according to the level of gasoline in the tank. The float is connected to a fuel sending unit (switch) which consists of a lever and variable resistor. As the float rises and falls, the lever moves across the variable resistor and establishes a current. The current passing through the resistor is converted into a reading on the dial of the fuel gauge.

The problem with a fuel gauge that doesn't work properly may be any one of the parts we have just mentioned. Start by replacing the fuel sending unit first. Then, concentrate on the gauge itself. And finally the float.

Build your own spiral stairs

By TOM JONES



AFTER PROVIDING adequate support beneath the floor joists, make the cutout, and spike headers and trimmers in place. Flooring has been omitted in the sketch so that the header and trimmer details can be clearly seen. The landing (actually the subfloor) is held by two pieces of angle iron welded to center column.

SEE ALSO

Basement stairwell . . . House additions . . . Railings . . . Remodeling . . . Stairs . . . Steps

■ FOR UNDER $100 you can build this wrought-iron circular staircase that takes up less space than a conventional stairway, is easier to keep clean, and will add beauty and value to your home. And you don't have to be a journeyman metalsmith to build it.

The materials needed are mostly black iron pipe and angle iron; both are available at most hardware stores. If you don't own an arc welder or a nailing gun, they can be rented for a small fee from a tool rental agency.

The amount of material needed will depend upon the height of the room and should be computed before any purchases are made. To build the stairs in an average 8-ft.-high room you will need 12 ft. of 2-in. pipe, 5 ft. of 2x2-in. angle iron and 35 ft. of 1x1-in. angle iron.

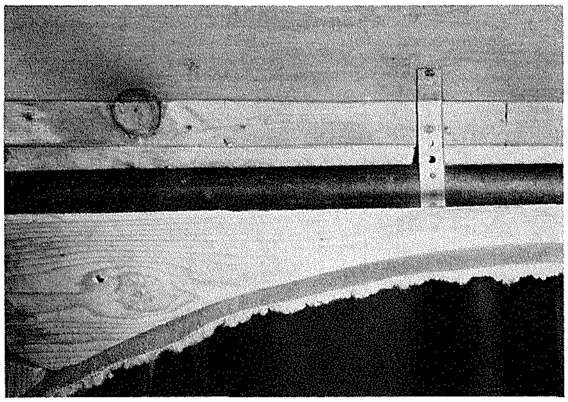
Using a sabre or keyhole saw, cut out the three-quarter circle and the two radii. Box in the quarter-circle radii with 2x4-in. stringers nailed into the subflooring and floor joists. Then cut two pieces of 2x2-in. angle iron to fit over the 2x4 stringers. Weld clips on one end of each angle iron and drill holes for bolting into the joists. Trim the opposite ends of the angle iron to a 2-in. radius for fastening to the center column.

The center column is a piece of 2-in. pipe with a pad welded on the bottom. Stand the pipe in the center of the cutout and weld it to the angle iron on the stringers, then bolt the stringers into the floor joists. Finally, check the column for plumb and shoot masonry nails through the pad and into the cement floor or anchor with bolts. Weld the nailheads to the pad and the main supporting structure of your staircase is complete.

The stephangers are made up of three pieces; the balusters or vertical supports, the rear supports that are welded to the bottom of the balusters, and the nosings which support the fronts of the treads. The balusters and rear supports are made of ¾-in. pipe and the nosing is made of 1x1-in. angle iron.

In order to determine the lengths of the balusters, first calculate the height of the risers (distance from the top of one tread to the top of the next tread). To find riser height measure the distance in inches from the lower floor level to the top of the upper level. Since 7½ in. is the desirable riser height, divide the total rise by that figure. The answer (if the number is fractional use the nearest whole number), gives the number of risers with a rise near 7½ in.

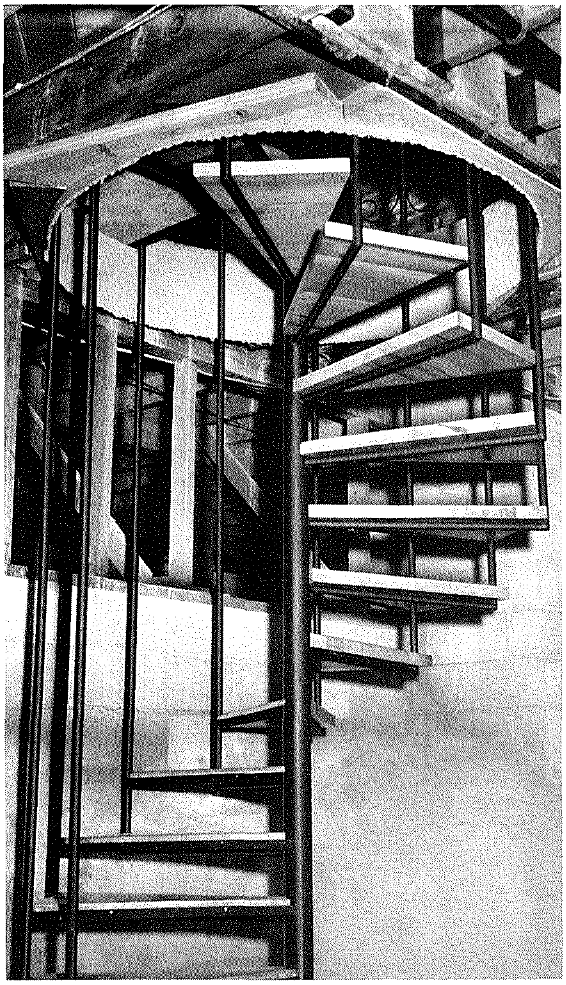
To find the length of the first (top) baluster, add the rise to 38 in. (for the tread thickness, 45° bevel, and the height of the baluster above the



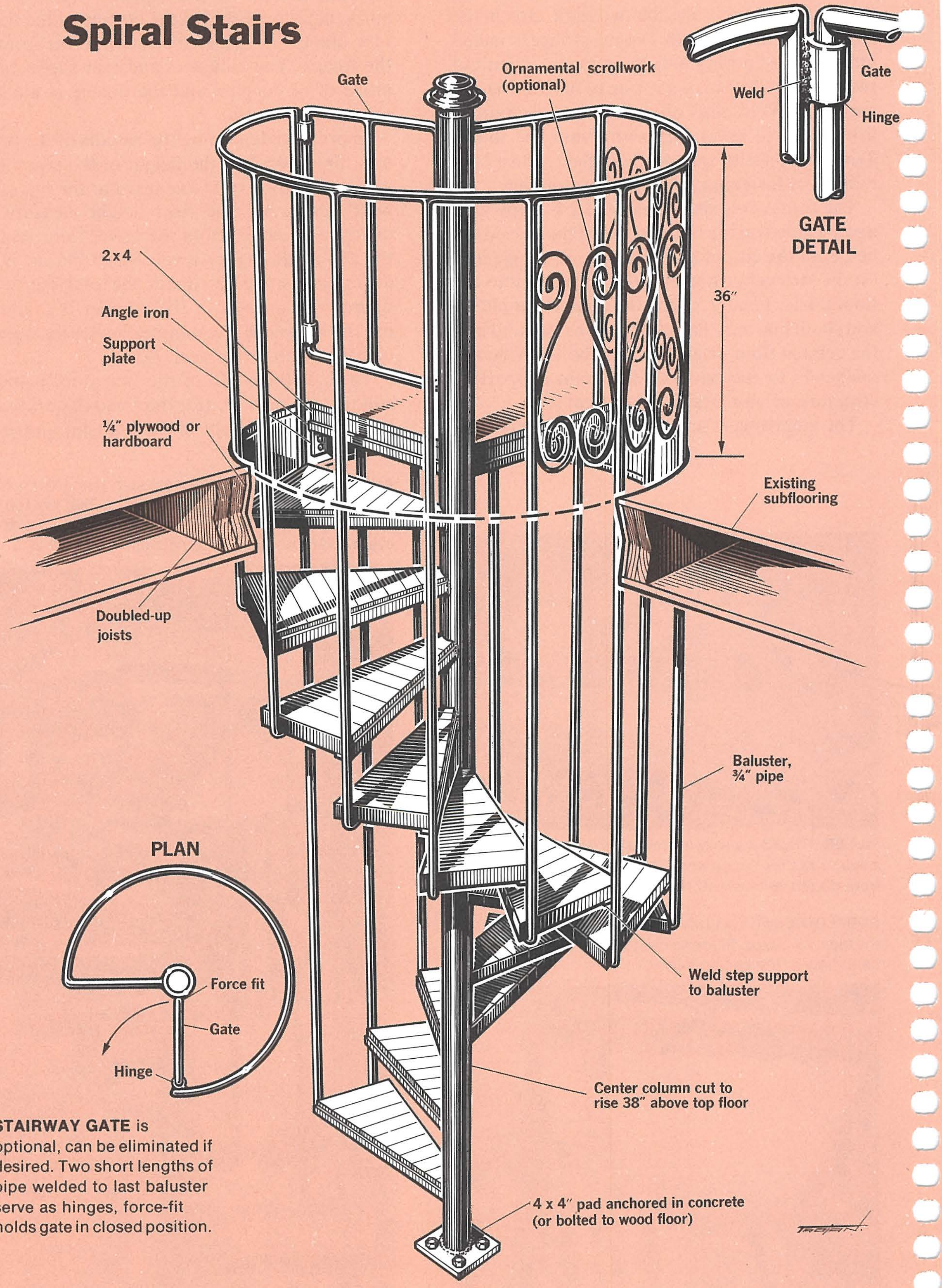
FILLER STRIPS are nailed around the opening to provide a solid base for the plywood that covers. Use carpeting from cutout to finish off the plywood circle.

SUBFLOOR held securely by angle bears the weight of the top three steps. Flooring can be painted to match the carpeting or the ceiling below.

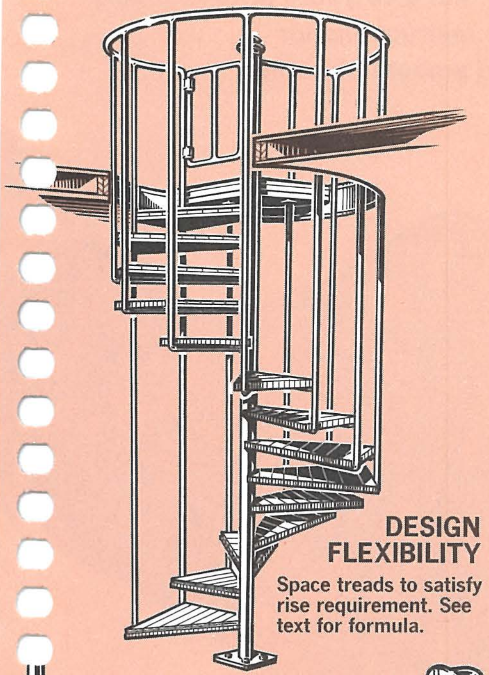
ANGLE-IRON supports are welded to the center column and bolted into the floor joists. Notice that the top three steps are bolted through subflooring. Treads are evenly distributed by spacing stephangers at 27°.



Spiral Stairs

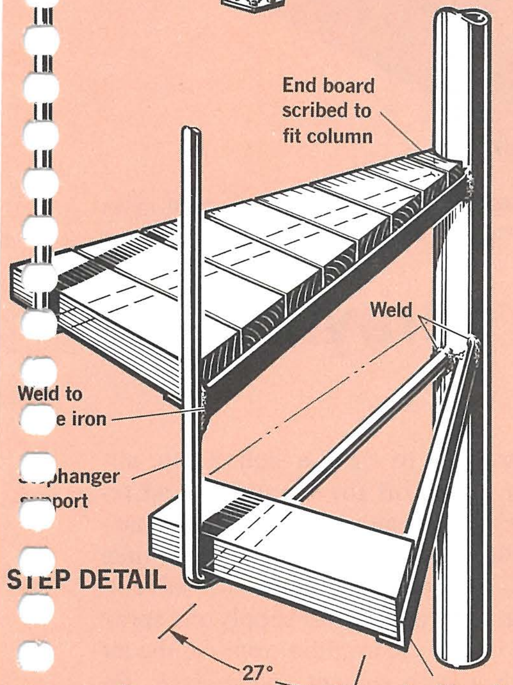

Gate
Ornamental scrollwork (optional)
Weld
Gate
Hinge
GATE DETAIL
36″
2x4
Angle iron
Support plate
¼″ plywood or hardboard
Existing subflooring
Doubled-up joists
Baluster, ¾″ pipe
PLAN
Force fit
Gate
Hinge
Weld step support to baluster
Center column cut to rise 38″ above top floor
4 x 4″ pad anchored in concrete (or bolted to wood floor)

STAIRWAY GATE is optional, can be eliminated if desired. Two short lengths of pipe welded to last baluster serve as hinges, force-fit holds gate in closed position.

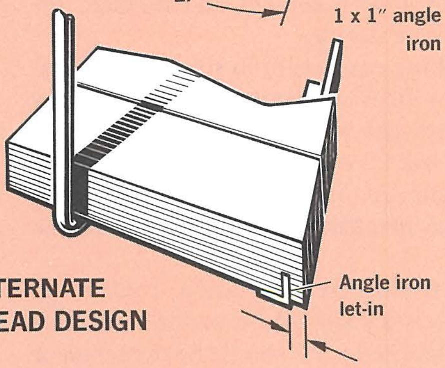


DESIGN FLEXIBILITY

Space treads to satisfy rise requirement. See text for formula.



STEP DETAIL



ALTERNATE TREAD DESIGN

upper floor level). On the first baluster only, add another inch to allow for a 45° miter on the top of the pipe; the rest are all cut square on one end and 45° on the other.

On each succeeding baluster, add the riser height to the length of the preceding baluster up to the tenth stephanger. Stephanger No. 10 should be approximately at the three-quarter point of the circle and should provide at least 6 ft. of headroom at that point.

To make the rear supports, cut 14 pieces of ¾-in. pipe 30 in. long with a 90° angle on one end and a 45° angle on the other. Match the 45s of the stringers and balusters together and weld square. Check with a level and weld the supports to the center column in descending order with 27° angles between supports (approximately 14 in. apart at the outer circle). Make certain that 36 in. of the balusters are protruding above the upper floor level.

help needed for balustrade

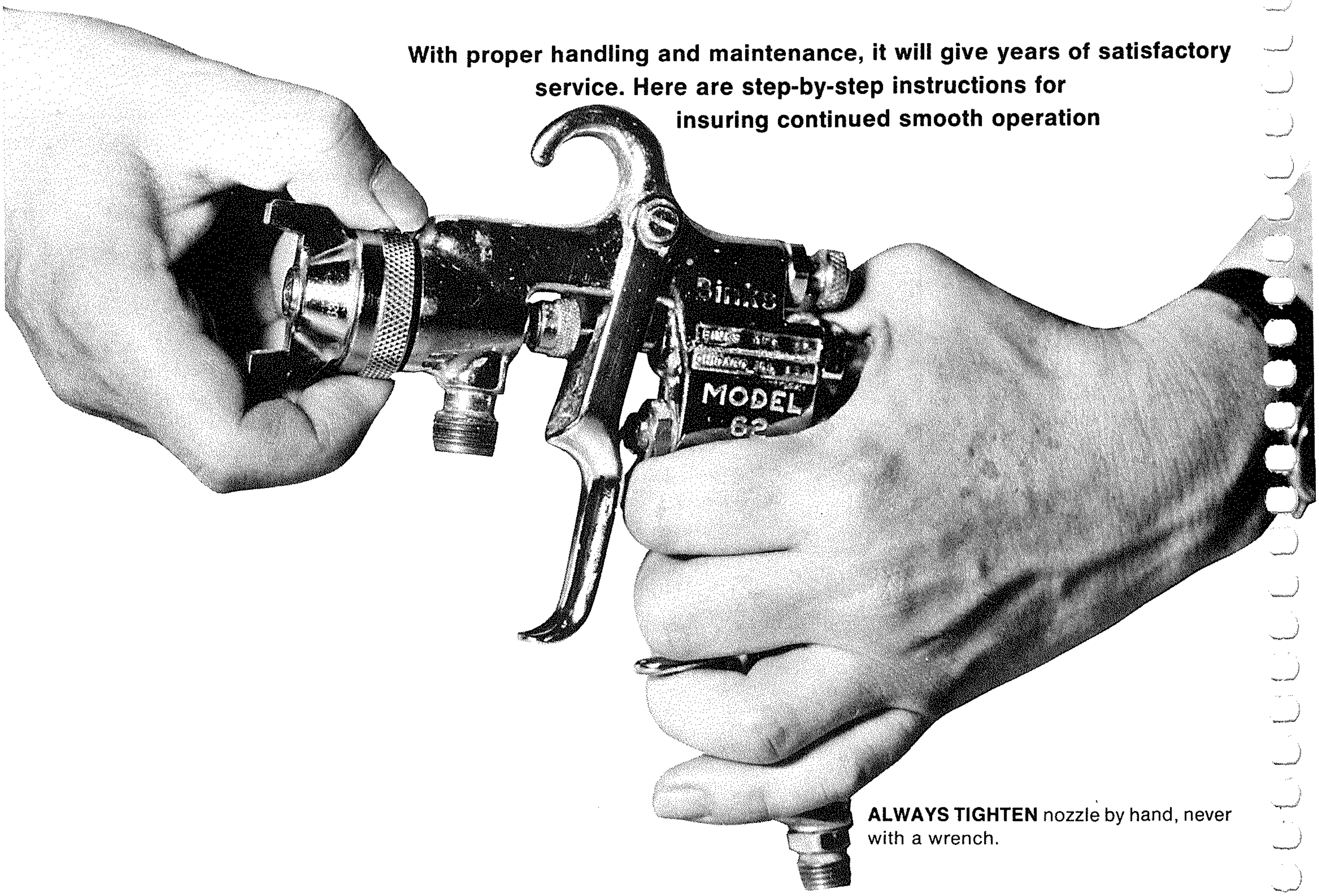
The balustrade forms the top railing of the staircase and ties the balusters together. Here, lacking the right equipment you'll need help from a pro. To make it, cut a ¾-in. piece of iron pipe 170 in. long. Take the length to a structural ironworking shop and have it rolled into a 5-ft.-dia. arc. Mark a spot back several inches on the arc to where the circumference begins to smooth out and cut a 45° angle in the vertical plane when the arc is lying flat. Trim a 45° angle on the first baluster and weld the two 45s together. Work the balustrade in an arc around the balusters, tack welding as you go.

After you've tacked the balustrade to the tenth baluster, cut off the excess railing on a 45° angle facing the center column and weld all joints. Cut a piece of ¾-in. pipe 30 in. long with a 90° angle on one end and a 45° angle on the other and weld between the end of the balustrade and the center column on a level with the top of the opposite side of the balustrade.

The tread braces are made of 1x1-in. angle iron cut to fit between the baluster and the center column. They should be welded in place level with the supports and screw holes drilled in them for fastening the treads.

The last three steps are installed by making up stephangers with clips welded on the upper end for bolting through the bottom of the subflooring.

Treads are made by gluing random lengths of 2x4s together, cutting them into wedges and installing them with screws.



With proper handling and maintenance, it will give years of satisfactory service. Here are step-by-step instructions for insuring continued smooth operation

ALWAYS TIGHTEN nozzle by hand, never with a wrench.

How to keep a spray gun spraying

■ THERE ARE several good reasons for giving your spray gun the care and attention that any precision tool deserves. That a quality spray outfit represents a pretty fair-sized investment is reason enough for many. But equally important is the fact that a tool kept in tip-top shape can mean hours saved on the job. And that's what any maintenance program is all about: to eliminate job downtime, or at least keep it to a minimum.

Investigations of complaints of defective guns usually reveal poor care or abusive treatment. Heading the list of causes is improper cleaning *immediately* after use.

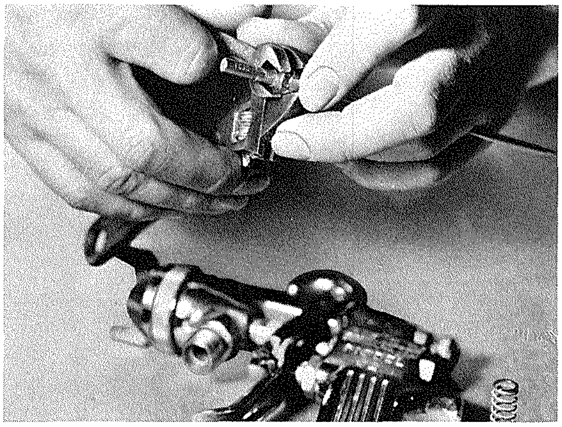
SEE ALSO

Compressors, air . . . Paintbrushes . . . Paint rollers . . . Painting, auto . . . Painting, exterior . . . Painting, interior . . . Painting, spray-can

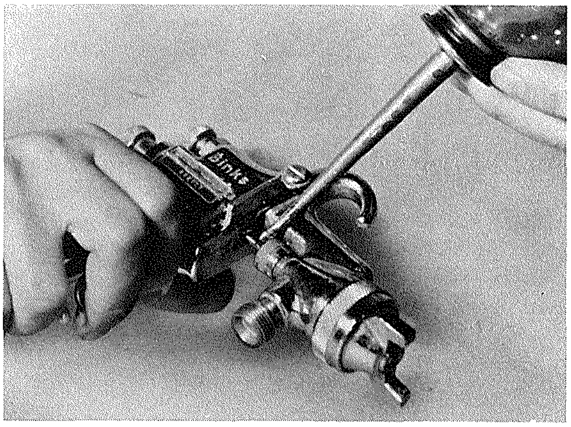
It's a simple task to clean a siphon-cup, air-atomized gun. Turn off the air supply and remove the cup from the gun. Allow as much material as possible to drain back into the cup, then wash it and fill it one-quarter full with solvent. Replace the gun, turn on the air supply and spray solvent until it runs clear. Next, remove the air nozzle, brush it with solvent and replace. Finally, wipe the exterior.

Avoid soaking equipment in solvent, particularly if small orifices are involved; there's always the possibility that when the adhered material dissolves, it will leave a residue of solids on *all* parts of the gun. Also, solvent removes lubrication from the mechanical parts and dissolves packing.

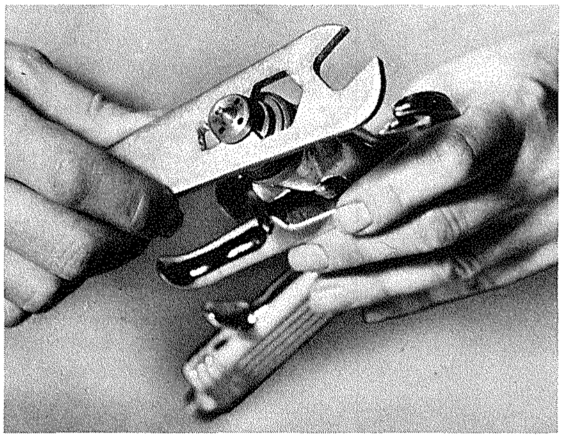
To insure trouble-free operation, certain design characteristics should be understood. For example, all knurled parts should be tightened or loosened with fingers only. Fittings intended for



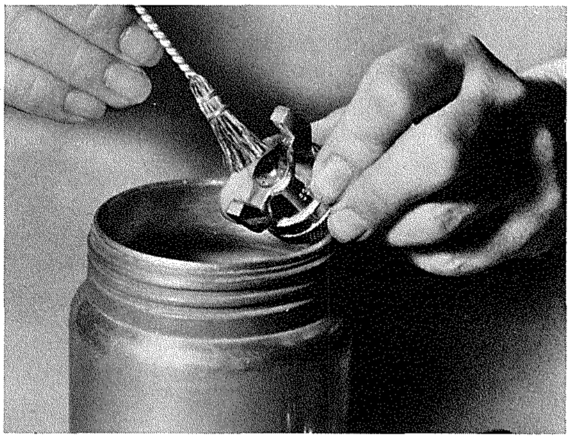
ONLY ADJUSTMENT for a spray gun is on the fluid needle. This nut can either be tightened or backed off to lengthen or shorten entire needle assembly.



APPLY LUBRICANT frequently to needle valve. Light machine oil is recommended. Do not use either grease or an oil that contains silicones.



USE THE RIGHT WRENCH when you replace the fluid nozzle. This tool should be thin enough so it will contact only the square portion of nozzle.



CLEAN NOZZLE ORIFICE using a stiff bristle brush (never wire). Brushing with a solvent usually will eliminate clogging; use only wood if pick is needed.

adjustment with a tool will have a hex, square, or slotted accommodation.

Make certain that you always use the proper-fitting wrench for fluid-nozzle replacement (never pliers). If too thick, it will override the square portion and possibly damage one or both of the tapered air seats. If these are damaged, discard the nozzle to prevent damage to the matching seats or tapers of the air nozzle.

There are several rules of spray-gun care that should always be followed as a matter of habit:

- If working on a spray gun in a vise, use soft jaws to protect the handle.
- Keep the tool lubricated per the manufacturer's instructions. If your gun is used daily, start each day by placing a drop of oil on the needle valve where it enters the fluid packing. Also, place a drop of oil on each side of the trigger stud.
- Lubricate the air and spring-needle valve springs with petroleum jelly about every six months. If your gun is of the automatic type, the piston leathers should be lubricated with the same grease.
- The only adjustment that must be made on a spray gun is to the fluid needle. Properly adjusted, it allows for the correct sequencing of events as the gun is triggered.

The first movement of the trigger opens the air valve to permit atomizing air to emit from the nozzle. Depress the trigger further to allow the spray material to enter into the already moving airstream. Release the trigger and the reverse sequence occurs. The reason for this is that air must always flow longer than the fluid to prevent globs on the workpiece.

Finally, if you have to correspond with the manufacturer, make certain you supply adequate information—model and parts numbers, material being sprayed, viscosity and solvent.

HERE'S WHAT YOU get in an unfinished pine chest of drawers—using the right stain for this popular wood.

Wood stains and how to apply them

Staining not only colors cabinet woods attractively, but also brings out all the natural beauty of the grain without changing its texture or other characteristics

By W. CLYDE LAMMEY

SEE ALSO

Finishes, wood . . . Furniture, care of . . . Sanding . . .
Wood finishes . . . Woods

■ BASIC STEPS OF A FINISHING schedule on close-grained woods are sanding, staining and finishing with topcoats. Staining is the one in between, and often it doesn't get the close attention it deserves, especially when the finisher is working with high-grade cabinet woods.

When a transparent finish is to be applied to fine woods, the natural color of the wood can be changed and the delicate graining emphasized by skillful application of the right stain to bring out the best in the wood. Often changing the color simply means a uniforming of the natural colors of the wood by light staining, or a slight darkening or lightening of the whole unit such as a cabinet, table or chair, to obtain effects pleasing to the eye or perhaps to match existing furnishings.

To do a stain job takes something more than a brush or cloth and a can of stain; it calls for imagination, visualization and an appreciation of the individual beauty of the woods you are staining. Don't try to force a wood to be something it isn't; that is, don't attempt to force it out of character by staining. Pine, for example, looks like pine only when it's finished natural or colored with a proper stain made especially for finishing this particular wood. Use the right stain and topcoat, and you end up with the beautiful patina of old pine. But if you stain this wood to be something it isn't, such as mahogany, you generally wind up with an unsightly, smeary something that's neither mahogany nor pine.

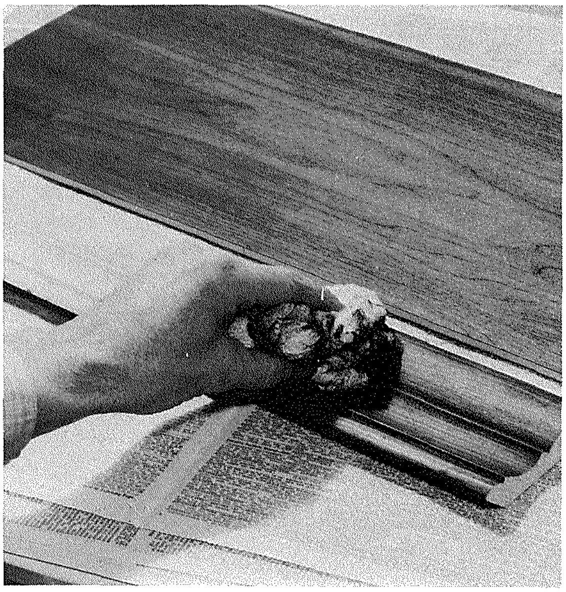
There are, of course, some woods that are more amenable to such deceptions. For example, most pieces made from cherry, birch or black willow, either new or old, will take a presentable walnut finish if it's skilfully applied, using the right materials. White ash can be made to look like oak—if not examined too closely—and the lowly poplar can be made up to look like maple,

THE TRICK IS to apply the stain, then wipe off the excess until you get just the shade you want.

MOST STAINS of a single type can be intermixed. Test combinations for the desired results.

staining wood, continued

MANY LIQUID stains can be either wiped or brushed on. Wiping is usually best on moldings for its more uniform application to the wood surface.



except to somebody who really knows his woods. In this sort of hybridization one may fool himself but he won't be likely to deceive the experts.

Real walnut can be colored the soft, reddish tone you often see on old work. But this finish does not conceal its true character and texture; it is instantly recognizable as genuine walnut. Likewise pine can be stained the light, reddish color often seen on old chests and the like; or it can be stained to the darker, brownish tones characteristic of some of the old colonial finishes. But pine it still is, even to the most casual glance.

All the common staining materials—with the possible exception of what are known as varnish stains—penetrate the wood in varying degree. And nearly all stains in liquid form will penetrate more deeply if warmed before application. (*Caution:* Never warm stains of any kind directly over a flame. Heat water in a pan and place the stain container in the warmed water.) When using most commercial stains you will be directed (in the instructions on the container) to apply the

ROLLER-STAINING works fine on wood paneling. Roll it on, wait for a partial set, wipe it off and that's it.

stain as it comes from the can, with frequent stirrings. When necessary, thin such stains only as directed.

Prepared stains are of several types. The most common are generally referred to as penetrating stains, oil (pigmented) wiping stains and the non-grain-raising stains (NGR). The colors are usually specified as "walnut," "maple," "brown" or "red mahogany," "light oak," "dark oak" and so on. Nearly all these stains can be intermixed to obtain lighter or darker shades.

If you require very close control of the depth of tone—as is necessary on some types of work—it's usually best to use a wiping stain. This material can be brushed on or applied with a clean cloth. After application, it's allowed to dry until the coating begins to lose its gloss (usually about 10 to 15 min.) and then the excess is wiped off to obtain the depth of color desired.

If it turns up a trifle too light, you let the coating dry overnight, then apply a second coat, allow to flat and wipe off again. In some in-

FOR LIGHT SANDING before staining, glue felt pieces to wood blocks and rounds cut from dowels. With these, you can smooth both flat and curved surfaces.

staining wood, continued

stances you may find it desirable to go through this same procedure a third time to get just the depth of color you want. But *don't* apply this stain and then allow it to dry without wiping off the excess.

On the other hand, if it turns out a little too dark after wiping and drying the first application, you can lighten the tone by rubbing out lightly with fine steel wool, 3-0 or finer. Do this carefully or you may undo all you've done to this stage, and may have to repeat the process.

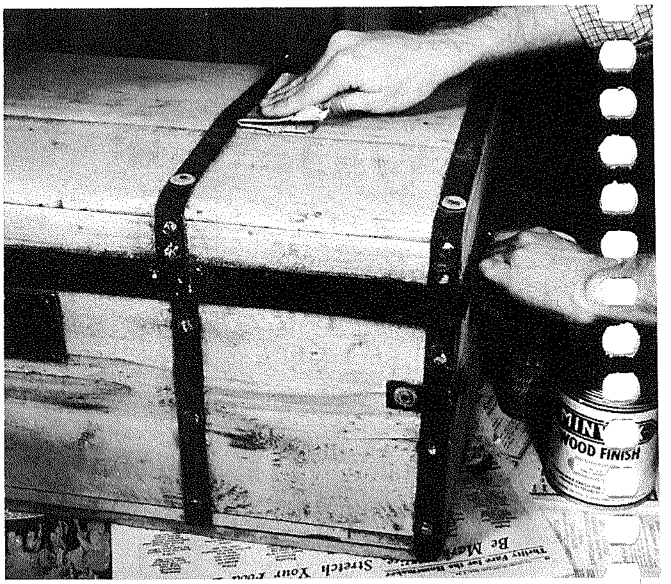
But before you do all this staining, there's a precautionary step or two to take. Suppose, for example, you are about to stain new wood such as that in a project you've made yourself from scratch, or one of those better quality ready-made pieces that comes to you in the "white," that is, unfinished. Before you touch any stain to the wood go over every surface to be colored inch by inch, running the tip of your finger lightly over every part, across the grain. In this way you'll discover rough places or "hills" and "hollows" that may escape your eye even in the best light.

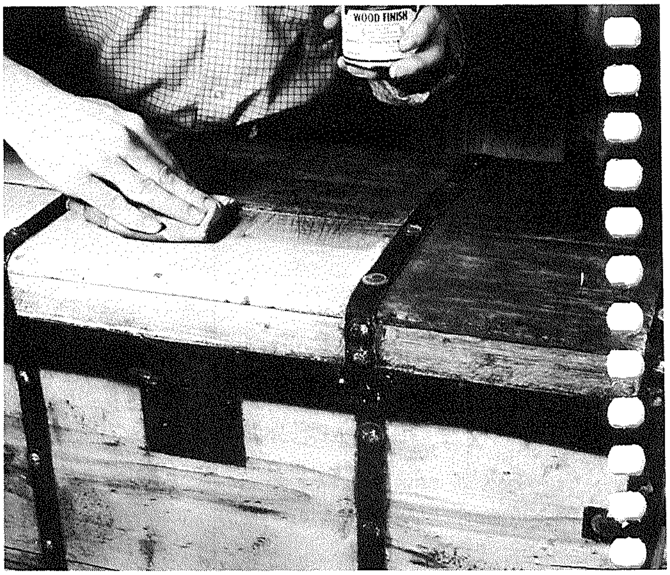
These surface defects must be dealt with before staining; otherwise you're in trouble. There may be a small area, or areas, where the grain ends up at an angle to the surface to be finished. Then you're likely to find tiny, hairlike projections of wood fibers —"whiskers," the refinishers call them. Such an area usually will soak up stain like a sponge and leave you with a darker blob that's near impossible to equalize with the adjacent surfaces. These upended fibers may slip past your eye but not the tip of your finger.

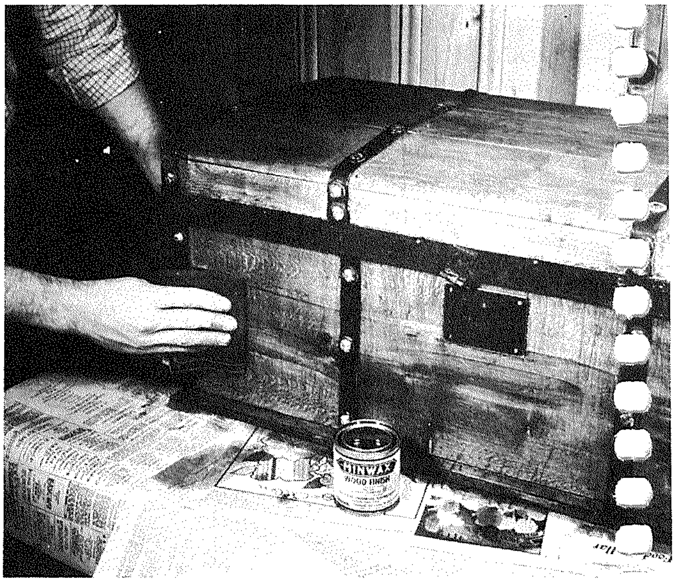
ridges and depressions

Also, there may be low ridges and depressions to search out and eliminate. Such surface defects will show up disappointingly under almost any finish—opaque (paint or enamel), glossy, rubbed-effect, semigloss, or even a self-leveling finish that dries flat. Of course, the ready-mades (unfinished pieces) are presumed to be thoroughly sanded, with flat surfaces and no fibers sticking up to fool you. But don't take the chance; finger-check the surfaces before staining. Likewise make one last finger-check on any made-it-yourself project. It may save you a lot of trouble later on.

Suppose you're going to refinish an heirloom or an antique for which you've shucked out a month's salary. After you've removed the dirt







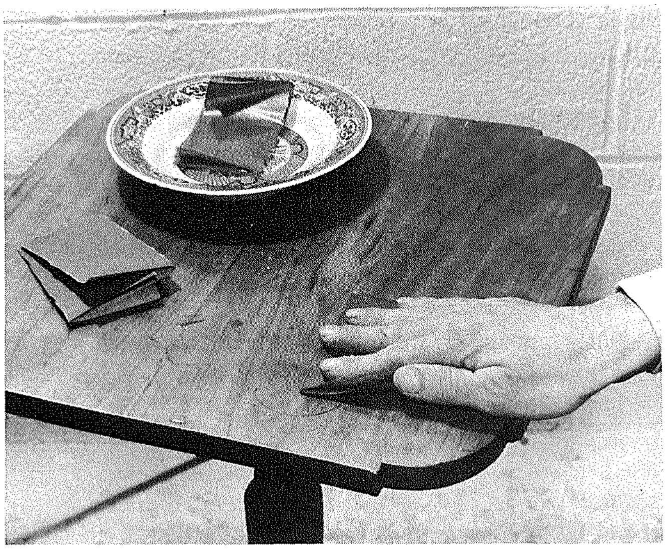
and paint accumulations of the years, you may find it's made of a half dozen different kinds of wood, several of which you can't identify with any certainty. Some are light in color, some dark, and some in between. What to do about it? Obviously it must be stained. But what stain?

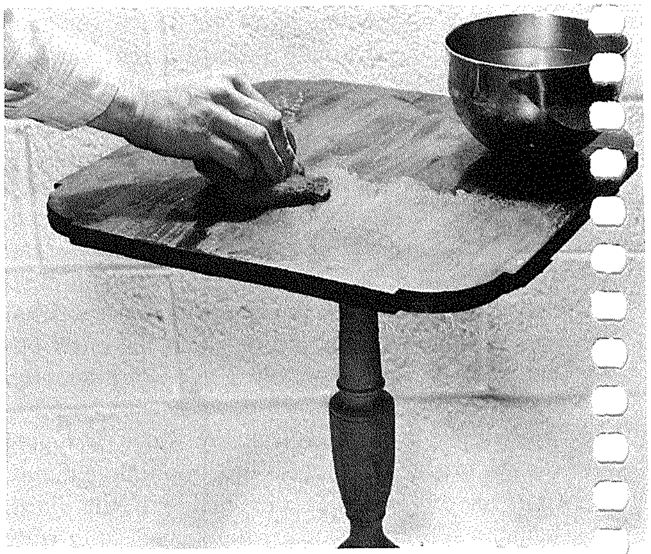
Or maybe the piece hasn't ever been painted, but has its original clear or stain finish. *Careful* is the word here! Perhaps you should forget about refinishing for the moment and see what can be done with the old finish. If the latter appears to be in reasonably good condition—no bad checks or areas worn down to bare wood—wash it lightly with soft, soapy water, wringing out the washcloth until it's little more than damp. Start in an inconspicuous place; if the finish lightens appreciably when dampened, *stop right there.* The finish is probably shellac or French polish; it may lighten and turn spotty if you wet the surface.

Otherwise continue with the wash, wiping the dampened surfaces with a dry cloth as you go; allow to dry a few hours and take a close look. If you like what you see, then let well enough alone. Waxing should bring back that old finish, almost like new. Use a wax especially prepared for use on old finishes.

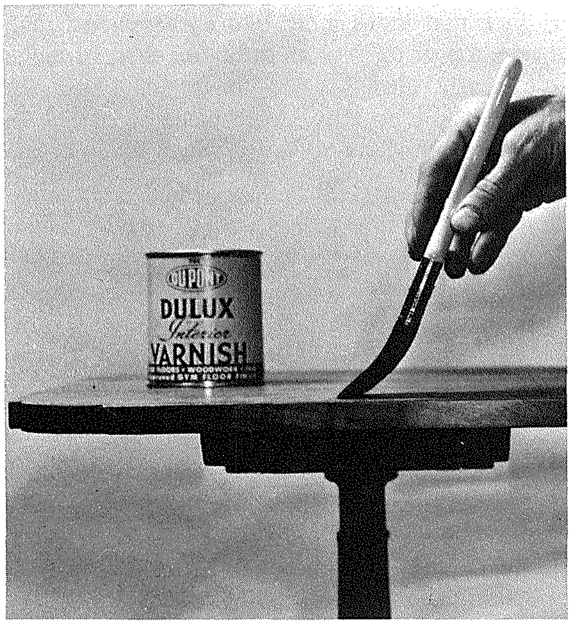
But suppose you *do* take off the dirt and old paint down to the bare wood and are confronted with the problem of refinishing a piece made from several differing varieties of woods. Usually it's best to pick out the darkest piece of the several woods and take it from there. Should there be only one dark piece, you might try bleaching it out to match the lighter parts. But this is not always safe; you may end up with a surface that looks more like a chessboard than a side, top or front of an orthodox chest or table. It's nearly always safer to try matching the lighter woods to that darker piece or pieces. In this case you have to judge which stain to use

THE ATTRACTIVE chest below has been sanded and is ready for refinishing. On the opposite page, top, careful sanding is a necessary preparation for adding a new finish. At left center is the "ragging on" of a combined stain and penetrating oil finishing material. Notice at the bottom left how the wood grain is brought out as the refinishing job approaches its completion. Careful, thorough preparation was the key.





DEFECTS YOU CAN'T SEE may be more important than those you can. A sensitive fingertip test (above, left) exposes flaws that would become obvious later. Steel wool (top) and solvent handle small blemishes. Keep the brush well filled and moving lightly (left).



staining wood, continued

solely by the color of the piece, or pieces, you are going to try to match. It isn't always easy to decide, but usually you can come pretty close by using one of the reddish or brownish stains, such as red or brown mahogany or walnut.

A pigmented wiping stain generally is best. You have better control and you can always remove the stain with a solvent if it doesn't turn out to suit. Run a line of the stain along the dark piece, wipe off the excess, and let the piece dry so you can see the effect. If you like what you see then continue the procedure on all the surfaces. If, for example, two adjacent pieces are of a varying shade, apply stain to both, then wipe the darker one first, allowing the stain to remain on the lighter one a few minutes longer. By proceeding in this fashion you can usually come up with an attractive stain job on almost any old piece made of conglomerate woods.

Actual application of a stain is quite simple, but there are a few precautions, whether you wipe it on with a cloth, brush it on or spray it on. In factories and refinishing shops, professionals usually spray-apply stains but unless you rent or borrow a sprayer you're left with the cloth or brush. Either works with the wiping stains, but as a rule any of the others such as the NGR stains are usually best applied with a brush. In any case you have to work fast and watch closely in order to obtain a uniform application. When applying stain to a large, flat surface such as a chest top or tabletop, allow the brush or cloth strokes to overlap slightly and keep going until the surface is covered. Then, after allowing that few minutes drying time, begin wiping where you started staining.

Use a light, quick sweep of the brush or cloth on end grain and wipe immediately. Some finishers apply a very thin wash coat of shellac or sealer to end grain to slow down absorption of the stain. On open-grain woods such as oak and mahogany, refinishers and finishers often combine stain with filler, intermixing the two until they get just the right consistency and tone. This usually works out well on old work where the remover may have taken off much of the original filler.

When staining work where you have to be especially particular about final results, have the piece in good light—outdoors when possible—so that you can see what's what. Stains don't always show their true colors under artificial lighting, especially under incandescent lights.

If you do rent a sprayer for application of the stain, run test panels until you have the nozzle set to give you a relatively fine mist. Whenever possible, do this on the same wood as that to be spray-stained. Be sure beforehand that the container and nozzle of the gun are clean, with no residues of paint remaining in either. Just to be sure, wash out the container with a solvent such as lacquer thinner; take the nozzle apart and clean it. Then reassemble the gun, fill the container about half full of the same solvent, and blow it all out through the nozzle.

When staining by spraying it's the usual practice to hit corners and edges first. Follow immediately by staining the flat surfaces with uniform back-and-forth strokes of the gun, holding it the same distance from the surface and keeping the wrist rigid so that the nozzle is held at the same angle throughout the length of the stroke. Release the trigger at the end of each stroke to avoid a double application at the finish ends. Remove any dribbles or sags by dabbing with the wiping cloth; don't let these dry even partially.

Stain applied with a spray gun usually sets up a bit faster than that applied with a brush or cloth, so keep a close watch and wipe off early enough to remove any excess.

Some finishers like the stains that come in a tube, like toothpaste. Just how you proceed in applying these stains depends on the instructions on the container. Read these carefully and follow through in all details.

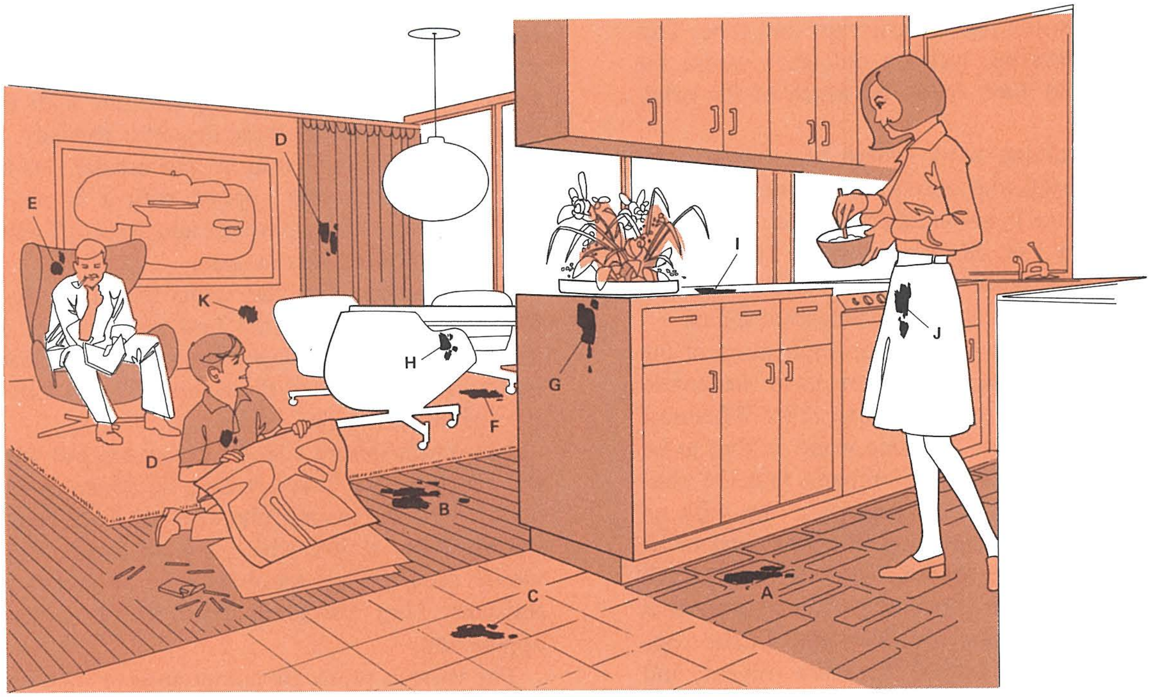
Non-grain-raising (NGR) stains are just what the name implies; they are light liquid stains that do not raise the grain of the wood as do the older water-soluble stains, which are no longer commonly used. Colors are brilliant, true and fade-resistant. They are suitable for spray or brush application.

The varnish stains are compounds of stain and varnish and serve the dual purpose of staining and finishing in one application. Other widely used finishing materials combine a stain with penetrating oils which provide a stain and finish in one or more applications. The latter finishes are generally topped with a final coat of special wax.

WHICH KIND OF FINISH IS BEST FOR WHICH KIND OF WOOD?

	Natural	Stained	Blonded	Colortoned	Antiqued	Enameled
Mahogany	AA	A	B			
Walnut	AA	A	A			
Cherry	AA	A				
Maple	B	AA	AA	A		
Birch	B	AA	AA	A	A	
Oak	B	B	AA	AA	B	
Sycamore	C	B	B	A	A	AA
Elm	C	A	A	A	B	A
Ash	C	A	A	A	B	A
Pine	C	AA	A	AA	A	A
Teak	AA					
Gumwood	C	B	C	B	A	AA
Tropical Hardwood	B	B	AA	AA		

AA—Ideal; A—Excellent; B—Good; C—Acceptable. Blank space indicates undesirable finish for the species of wood



TYPICAL HOUSEHOLD stains can be found just about anywhere: A, brick floor; B, wood floor; C, floor tile; D, washable fabric; E, synthetic fabric; F, rug; G, wood; H, nonwashable fabric; I, laminate; J, white fabric; K, painted surface.

How to remove stains from almost anything

■ ALMOST ANYTHING CAN, or will, stain something. There are staining agents that can cause spots on synthetic and natural fabrics, painted surfaces, masonry, marble and other surfaces commonly found in any home. However, most stains can be classified by types—and for each type there is an effective solvent that will break down and remove the stain.

On these pages are several charts listing the most common household stains, the solvents to use on them and the best methods to use to remove them. When removing stains, it's important to remember that it is possible a spot may be a combination of more than one staining agent. (For example, a machine oil stain could include traces of metal.)

Also keep in mind that a solvent that won't harm one type of fabric may harm another. Because of this, the choice of solvent is determined by both the stain and the fabric. Generally, water or a combination of water and a second solution, can be used on washable fabrics—but will not be effective on nonwashable fabrics.

Carbon tetrachloride, and other nonwater solutions, are useful on both types of fabrics. *Caution: Regardless of the type of solution used, and with carbon tet in particular, take time to read the manufacturer's instructions for using.* Follow all safety instructions and work in a well-ventilated area. If possible, work outdoors when using carbon tet or naphtha.

How you treat stains on white or colored fabrics is important, too: Inert solvents such as carbon tet, benzol, alcohol and water can be used on both colored and white fabrics. But avoid using active solvents such as citric, tartaric acids, alkali (ammonia or borax), laundry bleaches and hydrogen peroxide on colored fabrics. These will generally change the colors of dyes. There are four ways of applying solvents to fabrics for removing stains: 1) soaking, 2) applying pressure, 3) front sponging, and 4) back sponging.

SEE ALSO

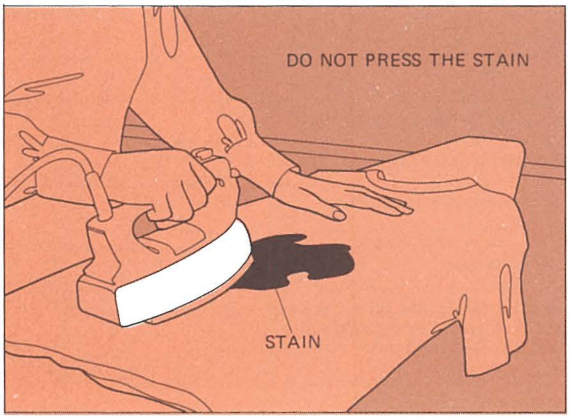
Concrete . . . Floors . . . Furniture, care of . . . Tile, floor

WHEN TO WATER-SPRAY STAINS PRIOR TO USING SOLVENT

RESPOND TO WATER SPRAY

- **Alcoholic beverages**
- **Blood**
- **Candy**
- **Catsup**
- **Chocolate**
- **Cocoa**
- **Coffee**
- **Egg**
- **Fruits, fruit juice**
- **Gelatine**
- **Glue**
- **Grass**
- **Ice cream**
- **Iodine**
- **Meat juice**
- **Mercurochrome (may need chemical treatment)**
- **Mildew (may need chemical treatment)**
- **Milk**
- **Mud (allow to dry first and brush)**
- **Mustard (yellow stain often impossible to remove completely)**
- **Perfume (wet immediately; may not be removable if set)**
- **Perspiration (wet immediately; may not be removable if set; may affect dyes)**
- **Soft drinks**
- **Sugar**
- **Tea (treat as soon as possible)**
- **Tobacco**
- **Tomato juice**
- **Toothpaste**
- **Wine**
- **Writing ink**

STAINS LISTED above generally will respond to a water-spray treatment before dry cleaning with a solvent. Blood must be removed before dry cleaning.


DO NOT PRESS THE STAIN
STAIN

DON'T SET THE STAIN

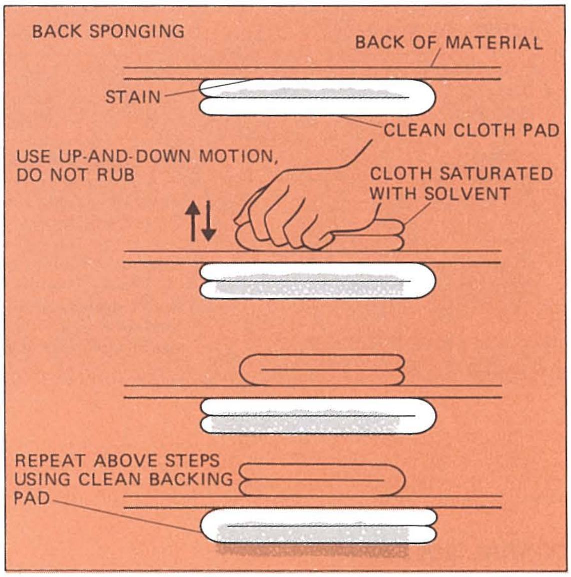
If a stain becomes set (fixed in the fabric), it can never be removed without some damage to the fabric. Thus, there are several rules of thumb you should follow to help safeguard against setting stains inadvertently:

1. Avoid heat. If a garment or slipcover becomes stained, *do not* press the stain, because heat sets stains.
2. Sponge stained areas as quickly as possible using lukewarm water.
3. *Don't* use home-spotting agents such as cleaning or lighter fluid. Check charts on these pages to determine which solvent and method to use.
4. Don't rub stain; sponge it as shown at right.

DO NOT REQUIRE WATER SPRAY

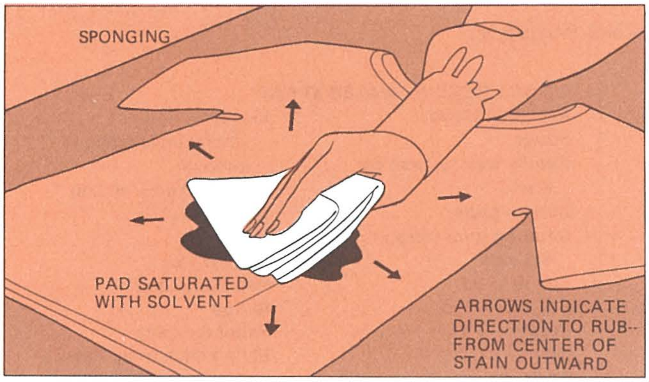
- **Adhesive tapes**
- **Butter**
- **Candle wax (scrape off first)**
- **Carbon paper**
- **Chewing gum (scrape off excess)**
- **Cod liver oil**
- **Crayon**
- **Cream**
- **Fats**
- **Floor wax**
- **Gravy (spray lightly to remove starch first)**
- **Grease, soil and tar**
- **Ballpoint-pen ink (may need chemical treatment)**
- **Lead pencil**
- **Linseed oil (if set, almost impossible to remove)**
- **Lipstick (some stains)**
- **Machine oil**
- **Mascara**
- **Mayonnaise**
- **Petroleum jelly**
- **Rouge**
- **Salad dressing**
- **Shoe polish (may require chemical treatment)**
- **Soot**

DRY CLEANING only is required by above stains. Some may call for special treatment—in some cases with chemicals (refer to the comments in parentheses).


BACK SPONGING
BACK OF MATERIAL
STAIN
CLEAN CLOTH PAD
USE UP-AND-DOWN MOTION, DO NOT RUB
CLOTH SATURATED WITH SOLVENT
REPEAT ABOVE STEPS USING CLEAN BACKING PAD

BACK SPONGING

To back sponge, place stained side face down on clean, absorbent material. Then sponge the back of the stain with a pad saturated with solvent appropriate for both material and stain. Important: Do not rub; rather, use an up-and-down padding motion. Final step is to replace the cloth pad below with a clean one and repeat the padding to remove all traces of stain from the fabric.


SPONGING
PAD SATURATED WITH SOLVENT
ARROWS INDICATE DIRECTION TO RUB—FROM CENTER OF STAIN OUTWARD

FRONT SPONGING

Sponging is probably the most frequently used method of removing stains from non-washable fabrics. Front sponging (applying solvent to the face of the fabric) works well with most grease solvents such as carbon tet. The stained fabric should be backed up with absorbent material or a blotter, and the rubbing strokes should be away from the center of the stain. Don't rub in circles over stained areas. This will only cause rings (of the stain) which will decrease in darkness as the circle, or stain, spreads.

COMMON STAINS AND THEIR TREATMENT

STAIN	HOW TO REMOVE IT
Coffee	Hot water; if stain remains, use oxidizing solvent.
Gum	Scrape off as much as possible; then use carbon tet.
Ink	Apply citric acid or oxalic acid—or apply these alternately with laundry bleach. Some colored inks can be removed with water or alcohol.
Iodine	Use hot water or alcohol; on starched material, use hypo.
Latex paint (fresh)	Use water, detergent, ammonia.
Latex paint (old)	Soak in ammonia.
Lipstick	Rub with lard or petroleum jelly; use grease solvent, detergent.
Mildew	Detergent; then use a laundry bleach or hydrogen peroxide.
Oil paint (fresh)	Remove oil with turpentine or benzol; then launder. On nonwashables, use carbon tet.
Oil paint (old)	Soak in ammonia or borax; then launder.
	NOTE: Before using any solvent on fabric, be sure it is safe. Test on scrap of same material if possible or try solvent on out-of-sight part (i.e. shirttail) of garment first.

TYPICAL SOLVENTS

SOLVENT CLASS	NAME OF SOLVENT
Hot water	
Inert solvents	Carbon tetrachloride*, benzol, turpentine and alcohol.
Oxidizing solvents	Laundry bleach and hydrogen peroxide*.
Detergents	Detergent solution, soap in alcohol.*
Acids	Citric acid, oxalic acid, tartaric acid, acetic acid (vinegar).
Alkali	Ammonia water, borax solution.
Reducing solvents	Hypo solution.
Lacquer solvents	Acetone, lacquer thinner.
	*Mildest solvent of its class; best for delicate materials.

TYPES OF STAINS

TYPE	EXAMPLES	SOLVENT	
		Washable Material	Nonwashable Material
Protein*	Egg, meat, blood, milk, cream	Cold water, detergent	Cold water, inert solvent, detergent
Grease	Petroleum jelly, fats, oils motor oil tar	Grease solvent, detergent	Grease solvent
Water-soluble	Sugar, candy, syrup	Water, detergent	Cold water† inert solvent, detergent
Dye‡	Fruit, grass, dyes	Hot water, oxidizing agent	Warm water mild oxidizing agent
Starchy	Flour, starch	Hot water, detergent	Inert solvent, detergent, warm water
Iron (rust)	Rust	Acid	Acid†
Solid soil	Mud, mud particles	Brush off, detergent, inert solvent	Brush off, detergent, inert solvent

* Do not use heat in any form or hot water.
† Sometimes usable by sponging; test before using.
‡ Do not use soap or alkaline substances.

ASPHALT AND VINYL-ASBESTOS FLOOR TILES

Stain-removal methods: A. Remove or wipe from floor. **B.** If freshly spilled, take up by blotting—don't rub; let dry. **C.** Wash with water-soaked rag. **D.** If dry, scrape off with putty knife. **E.** Wash with cloth dipped in liquid cleaner; rinse. **F.** Rub lightly with cloth dipped in alcohol and rinse. **G.** Rub with 00 steel wool dipped in liquid cleaner; rinse. **H.** If G fails, apply mild household cleaner rub thoroughly. **I.** Polish surface when completely dry.

STAIN	METHOD FOR REMOVAL
Asphalt adhesive	ADGHI
Alcoholic beverages	ACI
Blood	AGHI
Butter	DEI
Catsup	AEI or AGHI
Cement (household)	DGHI
Chewing gum	DGHI
Cigaret burns	GHI
Coffee	ACI
Detergents	ACI or GI
Dye	BGHI
Eggs	ACI
Foodstuffs	ADGHI
Fruit juice	AEI
Furniture polish	ADGHI
Grass stains	GHI
Grease (vegetable)	ADGHI
Ice cream	AEI
Lacquer	BEI or DGHI
Mercurochrome	BFI or BGHI
Mildew	GHI
Milk	AEI
Mucilage	BDEGHI
Mustard	AEI
Nail polish	BEI or DGHI
Oil (vegetable or petroleum)	AEI
Paint	BEI or DGHI
Rubber heel marks	GHI
Rust stains	GHI or A
Shoe polish	AGHI
Soft drinks	ACI
Solvents	BEI
Strong soaps	ACI
Tar	ADGHI
Tea	ACI
Varnish	BEI or DGHI

BRICK AND WOOD STAINS

Many types of stains on materials other than fabric can be removed by washing with a mild detergent. Where an oily substance has penetrated a wood (or concrete) floor, a poultice consisting of an oil solvent (such as turpentine) mixed with an absorbent agent—corn meal, for example—will usually do the stain-lifting job. Stains on marble tabletops can frequently be removed using this method. If the stain is still fresh, it is best to dust on the absorbent material, then apply a pad saturated with solvent. Ordinary stains that penetrate brick and stone masonry can usually be removed with this method, but in all likelihood, some degree of rubbing will be necessary.

How to lay out and build stairs

CHANCES ARE, the stairs a homeowner is most likely to replace are either in the basement or on the back porch. Interior stairs are generally of the more intricate housed-stringer type (below). This type should be left to professional stairbuilders.

You can build stairs either in your shop or at their location. Generally speaking, the more intricate the stair design, the better it is to do the building in the shop. But if you do, make certain you will be able to move the finished staircase into its position.

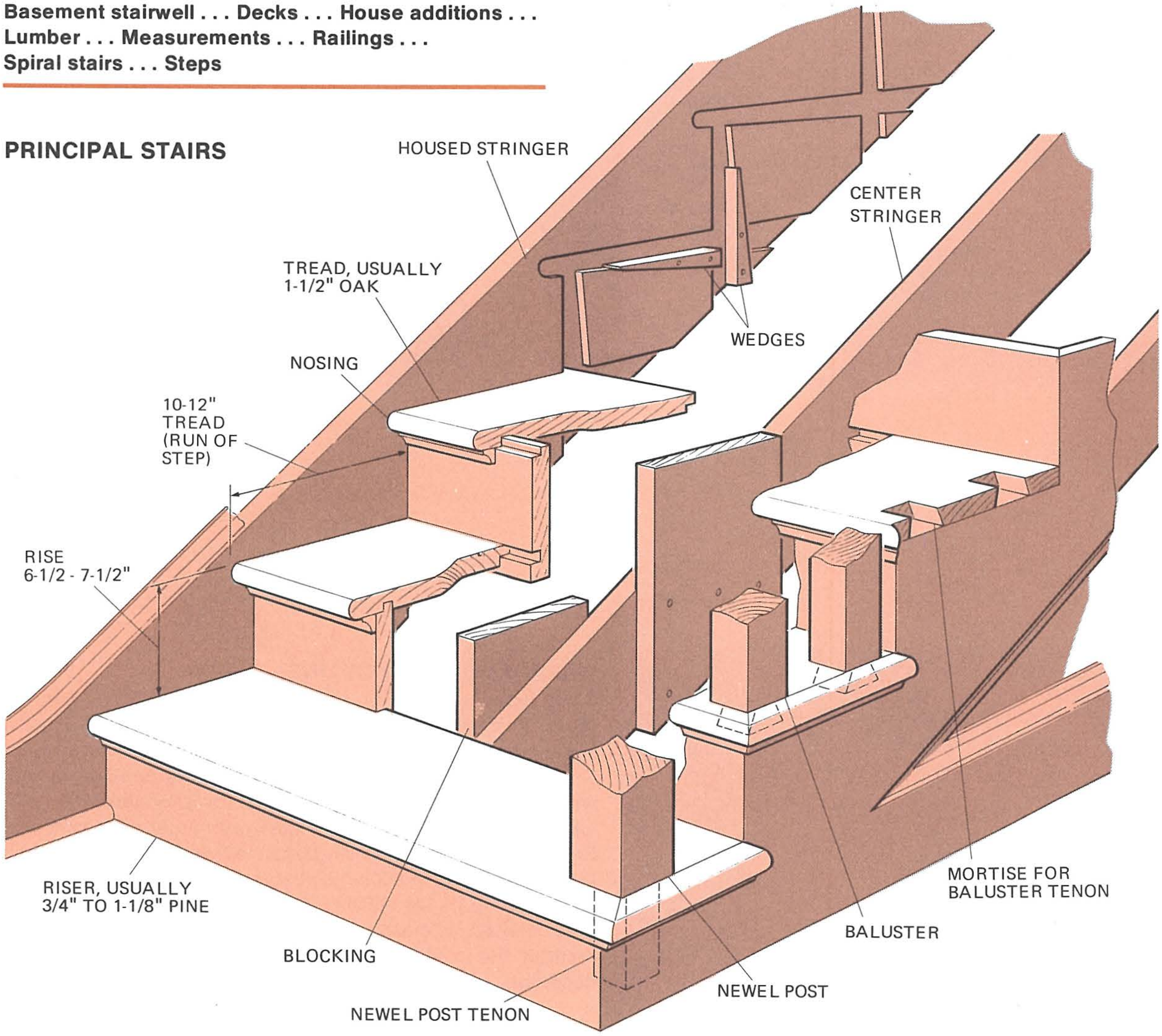
SEE ALSO

Basement stairwell . . . Decks . . . House additions . . . Lumber . . . Measurements . . . Railings . . . Spiral stairs . . . Steps

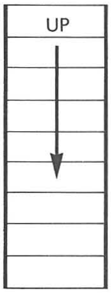
Three things to keep in mind when laying out and installing a stairway are safety, adequate headroom and space for the passage of furniture. If the stair rise is too steep or too shallow, the steps are sure to be difficult to ascend and descend, and could cause missteps and falls. Poor layout may result in inadequate headroom which could lead to bumped heads (for tall persons) and inability to maneuver furniture up or down the stairs.

In most homes, there are two types of stairs. Principal stairs are designed to provide easy, comfortable access to another level; they are architecturally coordinated to the room in which they are located. The second type, service (or basement) stairs, are generally steeper and constructed of less expensive materials.

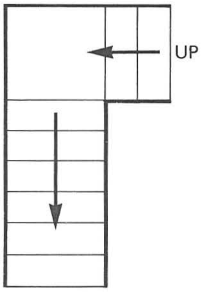
PRINCIPAL STAIRS


HOUSED STRINGER
CENTER STRINGER
TREAD, USUALLY 1-1/2" OAK
WEDGES
NOSING
10-12" TREAD (RUN OF STEP)
RISE 6-1/2 - 7-1/2"
RISER, USUALLY 3/4" TO 1-1/8" PINE
BLOCKING
NEWEL POST TENON
NEWEL POST
BALUSTER
MORTISE FOR BALUSTER TENON

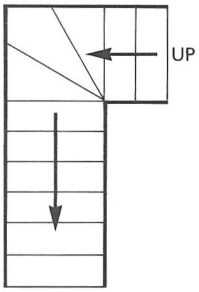
TYPES OF STAIRS



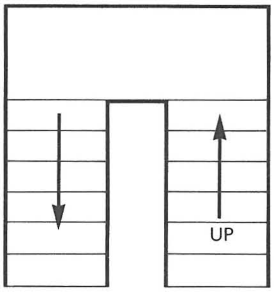
STRAIGHT



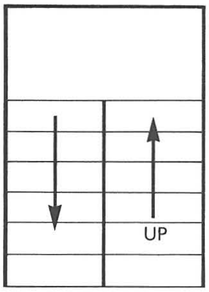
WITH LANDING



WINDERS



WIDE U-SHAPED



NARROW U-SHAPED

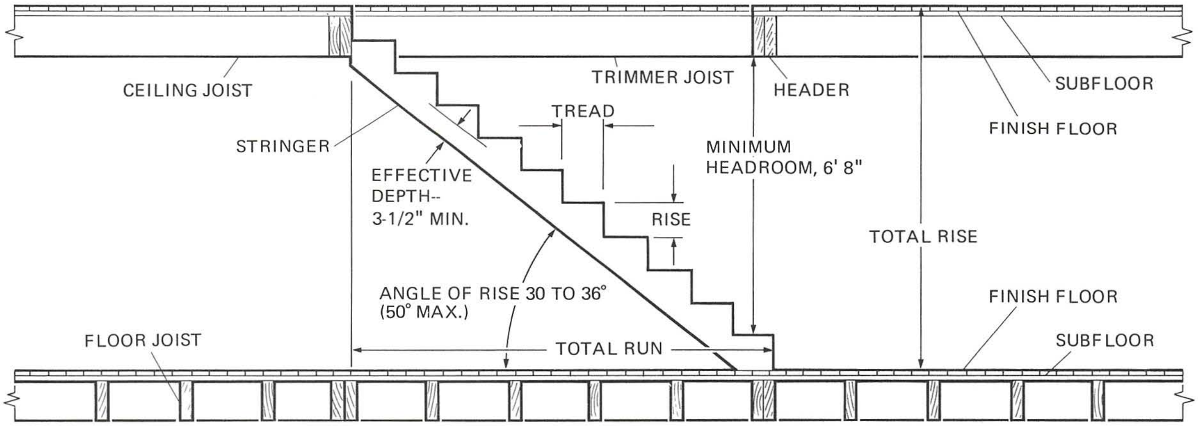
Stairways may have a straight, continuous run with or without an intermediate platform (landing), or they can consist of two or more runs at angles to each other. If your stairs must have an angle, it is at this point that the landing should be installed.

Another stair design incorporates winders—the turn is negotiated by radiating treads. For safety, if winders must be used, they should be installed at, or near the foot—not at the top—of the stairs.

Remember these points when laying out stairs:

1. Allow for minimum headroom of 80 in.
2. Generally, treads should be between 10 and 12 in. wide and risers should be 7½-in. high. The formula used by most professionals is: Twice the riser height plugs the tread width should equal 25. When you lay out your stairs, use risers that will put you close to that number.
3. Angle of the stairs should be between 30° and 36°.

STAIRWAY DESIGN



There is a definite relationship between width of treads and height of riser. All stairs should be laid out to conform with these well-established rules.

Any variance from these standards will result in awkward stairs which create a safety hazard and are tiring to use. If the treads are too short, the risers will be too high, so that your toe is likely to kick the riser on each step. But when the treads are too long, the risers will be too low, enough so that you will be making a conscientious effort to shorten your stride; this, too, is tiring.

Experience has proven that a riser of 7 to 7½ in. is about perfect. By using the formula mentioned you will find that the tread for a 7½-in. riser is 10 in. For comfort, as the riser gets shorter, the tread should be correspondingly wider. For example, a 6½-in. riser should have a 12-in. tread.

MATHEMATICS IN STAIRBUILDING

When replacing an existing stairway, you already know its location and width, but you will need to determine the correct height of the risers and width of the treads. (If a landing is to be included, consider it—for design purposes—as simply another step. Its length and width will be decided by the available space at the landing location.)

To figure the number of riser needed, you first select a suitable riser height. Then divide the total rise—distance in inches from top of the lower floor to top of the upper floor—by the riser height chosen.

If you get a full number as your answer, let it represent the amount of risers needed. Usually, however, the result will include a fraction. When this happens, divide the story (total) height by the whole number that's nearest (above or below) the fractional answer. The result of this second division will give the riser height. You can then proportion the tread by using the formula outlined on the preceding page.

In another formula to adjust riser height, you multiply the tread width by the riser height. Ideally, the answer should be as close to 75 as possible. Thus, a riser height of 7½ in. multiplied by a tread width of 10 in. gives the perfect combination—75.

Here's an example of such calculations, assuming a story height of 9 ft. 6 in., or 114 in. and riser height of 7½ in. When you divide the 114-in. story height by 7½ in., you get 15-$\frac{1}{5}$ risers. Obviously, you cannot have a fifth of a riser, so the nearest whole number to use in the next calculation is 15. In other words, you can assume that 15 risers will be required, so you now divide the total story height of 114 in. by 15 in. to get 7.6 in., or approximately $7\frac{9}{16}$ in. as the height for each riser.

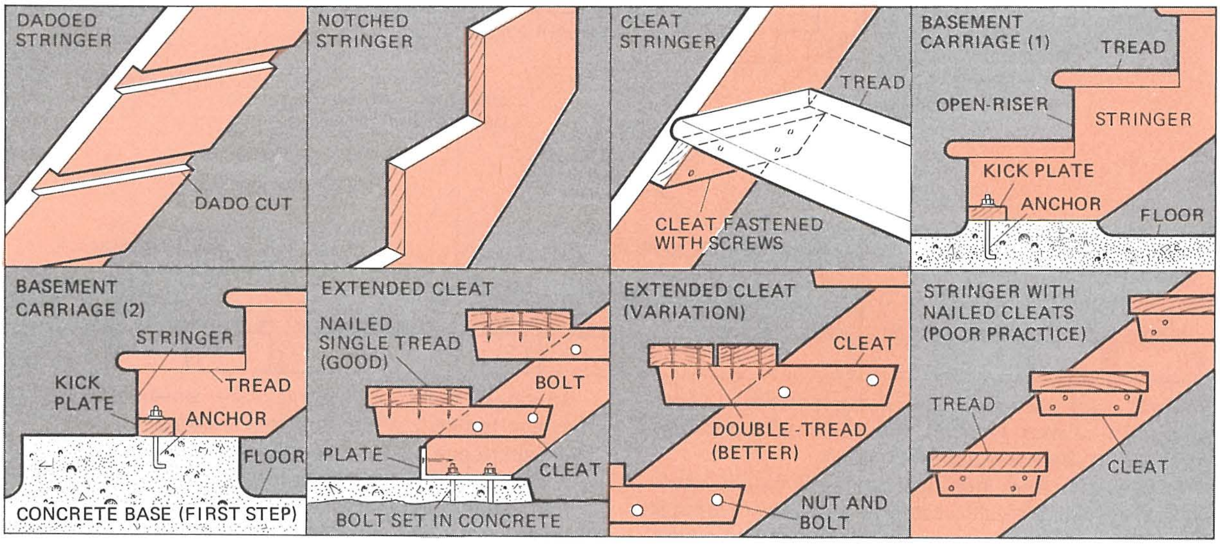
Next, to find the width of the treads, multiply the riser height by 2 and subtract this from 25. For example, 2 x $7\frac{9}{16}$ in. equals 15⅛ in. Deduct this figure from 25, which leave 9⅞ in. as the correct tread width.

Thus, the figures you should use for this example stairway are:

1. Risers: 15, each $7\frac{9}{16}$ in. high.
2. Treads: 14, each 9⅞ in. wide.

Note that there is always one more riser than the number of treads.

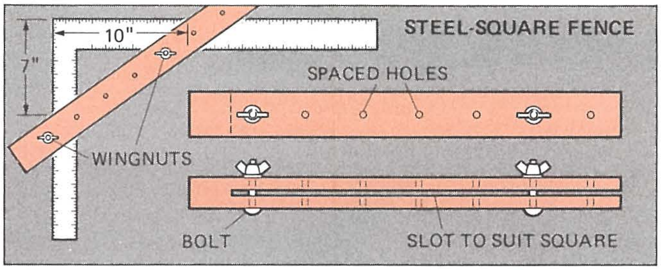
TYPES OF STRINGER (CARRIAGES)



PLANNING STRINGERS

Treads and risers should be fixed solidly to stringers that are set level and plumb. Several methods for fastening treads and risers to stringers are shown above. Stringers shown here can be built by a careful do-it-yourselfer. The intricate housed stringer (page 2874) with tapered dadoes and wedges is better left in the hands of a pro.

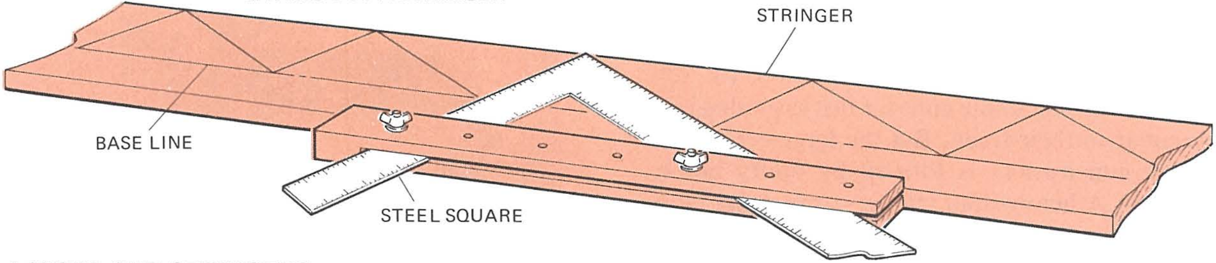
In contemporary architecture, open stairways are frequently called for; that is, no risers are used. This type of stairway is becoming increasingly popular as modern architecture comes into greater use. However, when you contemplate replacing a stairway in an older home, the stair design should remain conventional—unless the entire home decor is being changed—in order to conform to the house style. It's safe to say that in a majority of cases a stairway should be replaced by a design that is similar to that of the original stairway.


STEEL-SQUARE FENCE

FOR ACCURACY, USE A FENCE

It is just about impossible to lay out a stringer accurately without an aid such as the fence shown at left. Use hardwood and simply bore a series of in-line holes down the center of the fence to accommodate a pair of wingnuts. Then, saw a slot through from the top to the bottom so that the fence can be used on the square as shown.

LAYING OUT A STRINGER



LAYING OUT STRINGERS

Since lumber shrinkage is one of the stairbuilder's worst enemies, you will be wise to use only well-seasoned lumber. If you plan to construct a principal stairway, you can purchase treads and risers of standard widths from a local lumberyard. Most yards also stock (or can quickly get) standard oak treads that are dressed to an actual thickness of $1\frac{1}{16}$ in. These days it is not uncommon to find risers constructed of 1-in. pine (actual dimension, ¾ in.). But since there is less chance of cupping and warpage with the heftier stock, you'll find it better to use 1⅛-in. material (5/4-in. stock).

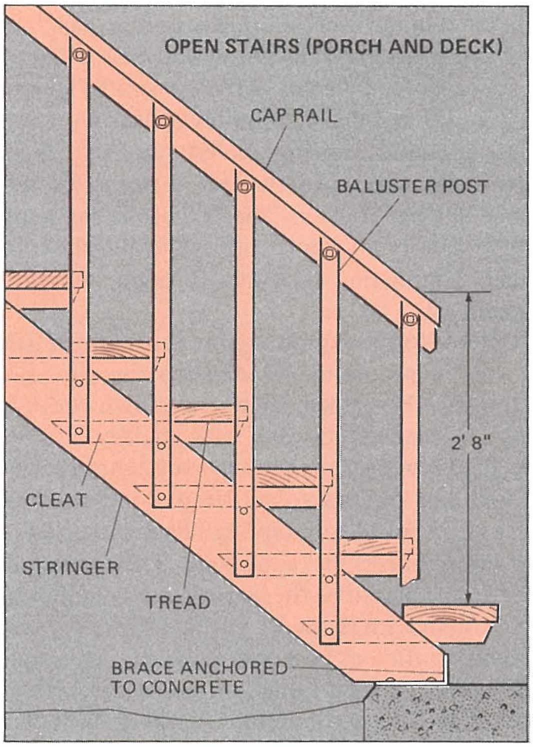
Starting steps (with curved ends), newel posts, handrails and balusters also are stock items carried by most building-supply outlets.

Secondary stairs are generally built using 2x6, 2x8 or 2x10 lumber for the stringers and treads. If risers are to be installed on such a stairway, they can be of ¾-in. stock.

After calculating the number of risers and treads required, and their respective height and width, begin by laying them out on the stringers as shown in the above sketch using a steel framing square. Your layout must be accurate.

After riser and tread positions have been indicated on the stringers, you can proceed with construction of the stairs. Stringers can be cleated, dadoed or notched, depending on your preference. If they are of the latter type, for structural reasons you must adhere to the 3½-in. minimum distance between base line and edge of stringer as shown in the drawing on page 2875.

If stringers are to be dadoed, construct a template or jig from ¼-in. plywood which can be clamped or tacked to the stringers to guide your router. When you're satisfied that the jig is accurate, make match marks on it so that it can be aligned accurately on the stringer each time it is relocated. The jig design should allow at least one riser and one tread groove to be made with each clamped setup.

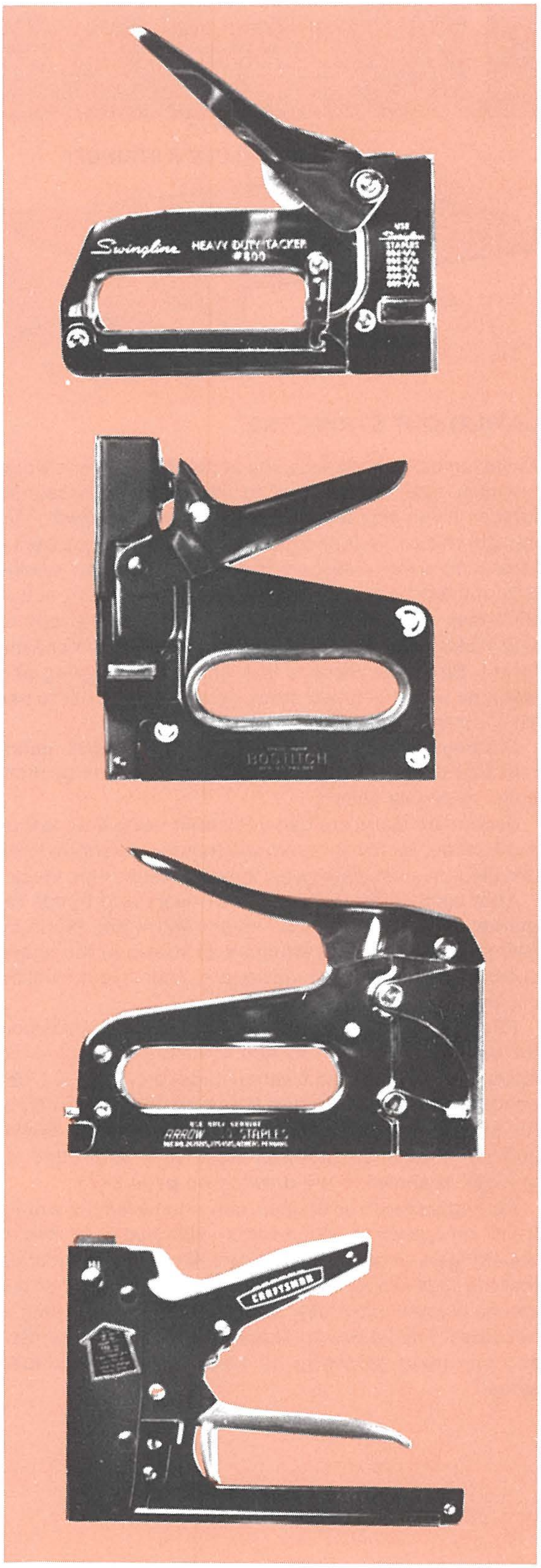

OPEN STAIRS (PORCH AND DECK)

ABOUT HANDRAILS

For safety—particularly for the elderly—all stairways should have a handrail. On a closed stairway, it is simply attached to the wall using handrail brackets. On open stairs, the handrail is located atop balusters which end against a newel post at the foot of the stairs. Usually balusters are dovetailed into the treads, but they can be installed by toenailing three or four finishing nails into the tread. If you use the latter method, predrill pilot holes to prevent splitting the hardwood treads. Regardless of stair style, handrails should always be 32 in. above the tread at the riser line.

Staple guns make work go fast

By JOHN BURROUGHS



■ ALTHOUGH MANUFACTURERS tag them "spring-type gun tackers," over seven million users call them staple guns.

Builders, farmers, upholsterers, cabinetmakers, boat builders and telephone and TV servicemen all use staple guns for fast fastening jobs peculiar to their trade. But the largest group of staple-gun owners is formed by crafty homeowners. A heavy-duty stapler—one using large flat-wire staples—is so handy for so many miscellaneous tacking jobs that the tool is a near-must in a home workshop. There's no easier-to-use, more practical and automatic fastening tool.

All leading makes of gun have similar mechanisms. Working a handle-lever lifts and then trips a heavily spring-loaded ram that slams down on a staple in the gun's magazine with some 200 lbs. of force. That's more than enough power to force a staple through ¼-in. plywood, sheet aluminum or even through tempered hardboard.

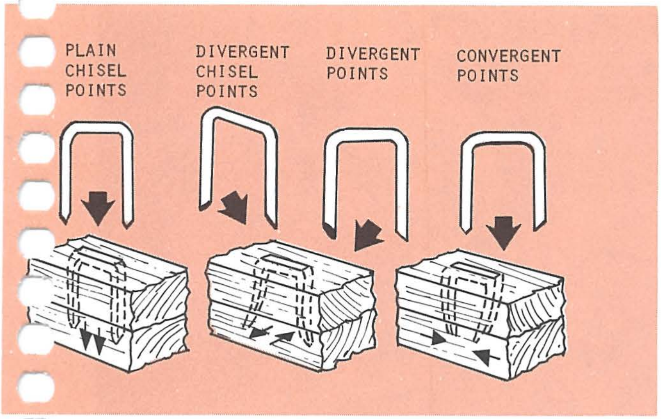
Staples for heavy-duty guns are made of .050-in. steel wire and measure approximately ½-in. across the flat crown. Since the crown width for some leading makes may vary slightly, it's best to stick with the same brand of staples as the gun.

You can buy staples in lengths varying from very short (used for stapling fabric coverings to car-door panels) to $^{9}/_{16}$-in. long. The right staple for the job should be the largest size your gun can drive flush with the work surface. A heavy-duty gun has sufficient power to drive $^{9}/_{16}$-in. staples into soft pine. The same gun, however, will not drive that long a staple into hardwoods such as oak or maple. Accordingly, shorter staples must be used with any of the harder wood species.

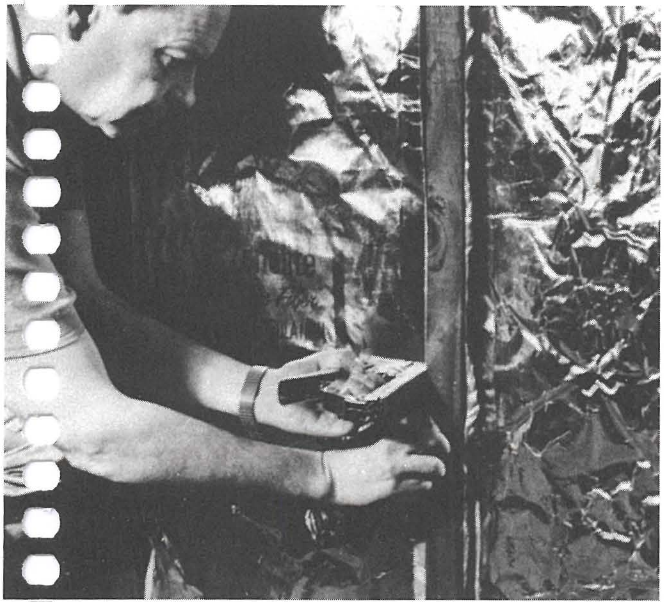
Using a short staple in hardwood, however, does not decrease the available gripping power,

SEE ALSO

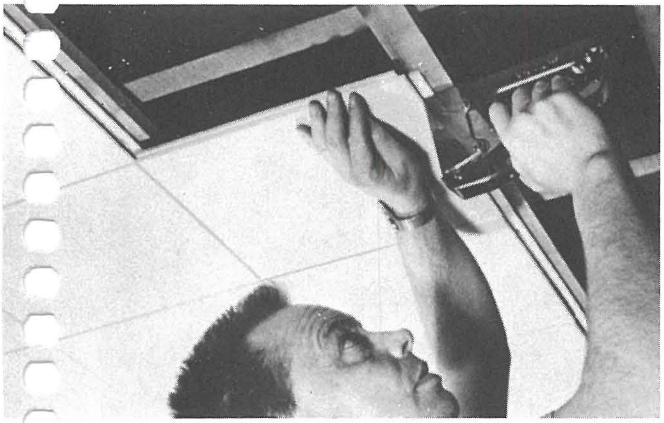
Bolts . . . Ceilings . . . Fasteners . . . Insulation . . . Nails . . . Riveting . . . Screens . . . Screws . . . Tools, hand . . . Torque wrenches . . . Upholstery . . . Wrenches



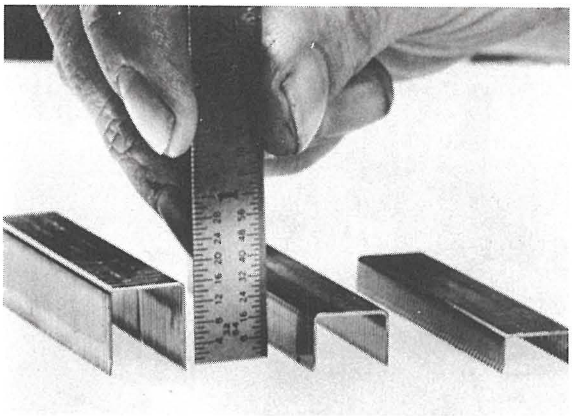
COMMON STAPLES have plain points and shear their way straight into wood. Other points increase grip by separating legs or by forcing them together.



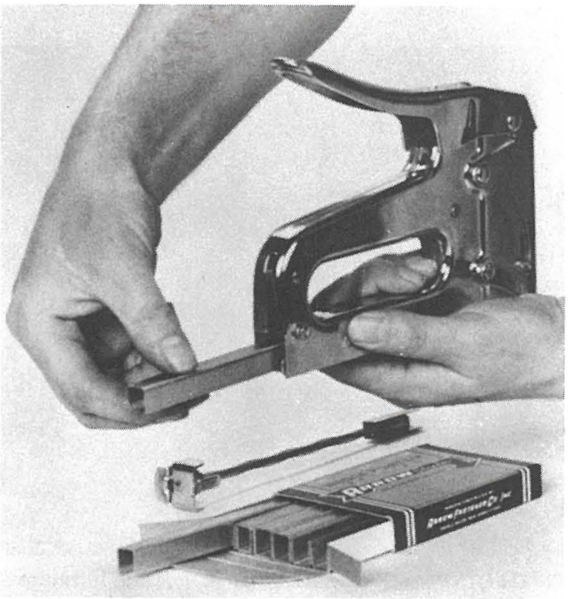
TO INSTALL foil-backed, glass-fiber insulation, staple the batt's side tabs to studs with ⅜-in. staples spaced every 2 in. Avoid compressing batts between studs.



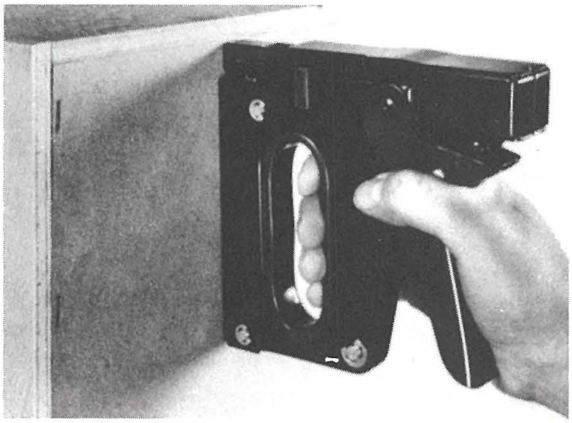
STAPLING IS THE EASY WAY to install ceiling tile. Nail furring strips across joists, then attach tiles to furring strips using special cement-coated staples.



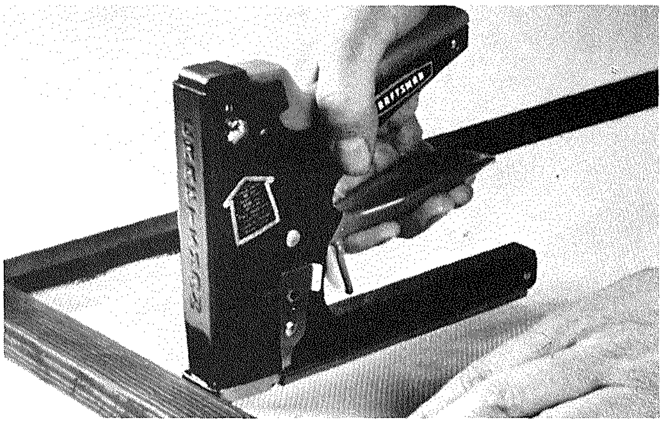
HEAVY-DUTY STAPLES are available with leg lengths of ¼, 5/16, ⅜, ½ and 9/16 in. All are lightly cemented together to form long, easy-to-load sticks.



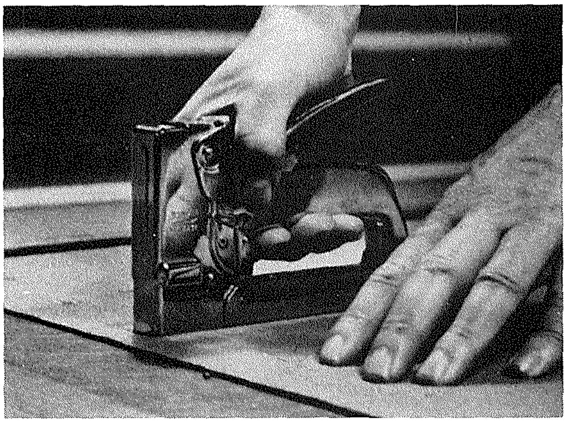
ALTHOUGH LEG LENGTHS may be standardized among various makes of staples, width of crown can vary from make to make. Always match staple to gun.



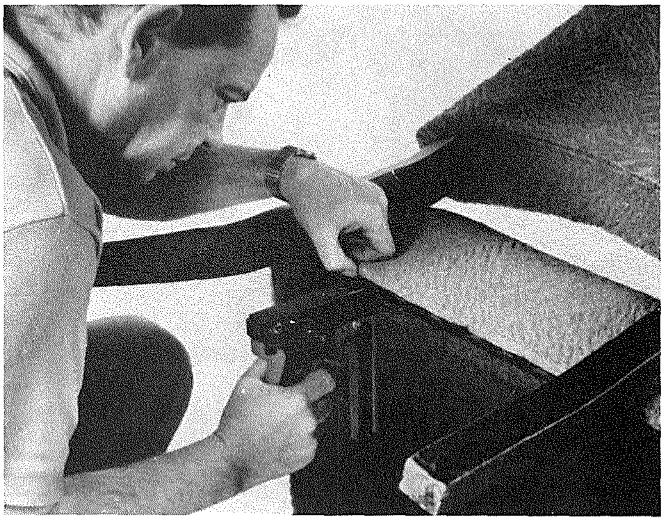
USE LONG STAPLES AND GLUE for permanent joints. Hardboard fitted in rabbeted cabinet backs or in drawer sides calls for use of glue-and-staple method.



MAKE WINDOW SCREENS by half-lapping rabbeted 1x2s to form a frame. Staple screening in rabbets. Attaching handy gun accessory stretches screen taut.



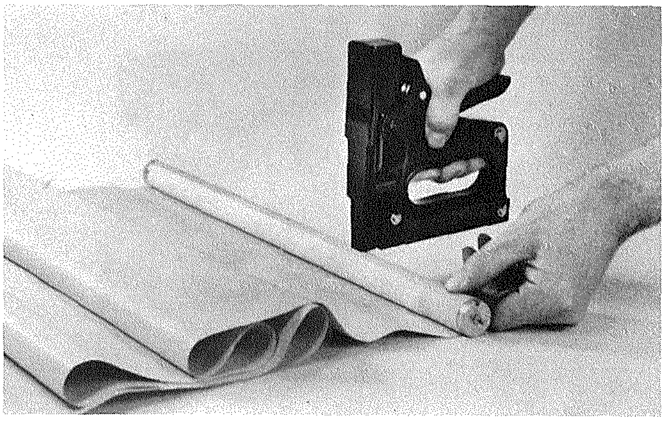
STAPLING DOWN CARPET PADS anchors them safely and prevents bunching. When taking up the pad, all you'll need is a screwdriver to pry out the staples.



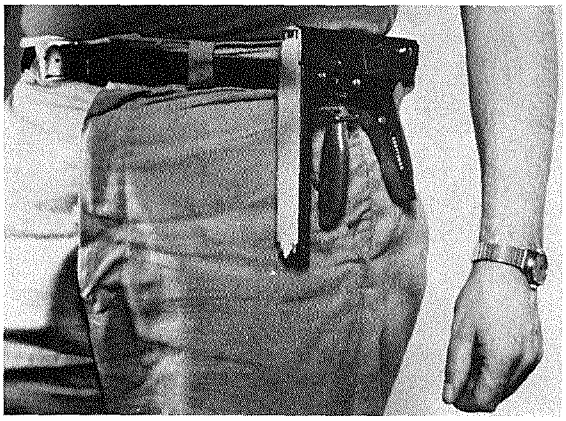
WHEN STAPLING UPHOLSTERY to wooden furniture frames, use the longest staples your gun will drive flush. Staples hold stretched fabric better than tacks.

since the grip of a short staple in hardwood is comparable to that of a long staple in softwood. Ordinarily, a staple will hold adequately if it penetrates at least ¼ in. of the substrate—the material into which the staple is driven. In some materials, a staple will withstand a 100-lb. pulling force. Should extra holding power be required, you can switch to a cement-coated staple, or you can use staples with special points that either twist the legs away from each other, or force them towards each other. Such staples are shown on the preceding page.

The popular makes of gun all are built of heavy-gauge steel and are practically indestructible. Manufacturers warn, however, against snapping the gun's action with an unloaded magazine, as this can considerably wear the ram stop and shorten the tool's life.



USE SHORT STAPLES for such jobs as securing shades to rollers, tacking shelf coverings, lining drawers. Short staples are a bit cheaper than long ones.



A BELT CLIP to hang your gun is an accessory item for some models. It's especially handy when stapling materials that require the use of both hands.

METRIC CONVERSION

Conversion factors can be carried so far they become impractical. In cases below where an entry is exact it is followed by an asterisk (*). Where considerable rounding off has taken place, the entry is followed by a + or a - sign.

CUSTOMARY TO METRIC

Linear Measure

inches	millimeters
1/16	1.5875*
1/8	3.2
3/16	4.8
1/4	6.35*
5/16	7.9
3/8	9.5
7/16	11.1
1/2	12.7*
9/16	14.3
5/8	15.9
11/16	17.5
3/4	19.05*
13/16	20.6
7/8	22.2
15/16	23.8
1	25.4*

inches	centimeters
1	2.54*
2	5.1
3	7.6
4	10.2
5	12.7*
6	15.2
7	17.8
8	20.3
9	22.9
10	25.4*
11	27.9
12	30.5

feet	centimeters	meters
1	30.48*	.3048*
2	61	.61
3	91	.91
4	122	1.22
5	152	1.52
6	183	1.83
7	213	2.13
8	244	2.44
9	274	2.74
10	305	3.05
50	1524*	15.24*
100	3048*	30.48*

1 yard = .9144* meters

1 rod = 5.0292* meters

1 mile = 1.6 kilometers

1 nautical mile = 1.852* kilometers

Fluid Measure

(Milliliters [ml] and cubic centimeters [cc or cu cm] are equivalent, but it is customary to use milliliters for liquids.)

1 cu in = 16.39 ml
1 fl oz = 29.6 ml
1 cup = 237 ml
1 pint = 473 ml
1 quart = 946 ml
= .946 liters
1 gallon = 3785 ml
= 3.785 liters

Formula (exact):
fluid ounces × 29.573 529 562 5* = milliliters

Weights

ounces	grams
1	28.3
2	56.7
3	85
4	113
5	142
6	170
7	198
8	227
9	255
10	283
11	312
12	340
13	369
14	397
15	425
16	454

Formula (exact):
ounces × 28.349 523 125* = grams

pounds	kilograms
1	.45
2	.9
3	1.4
4	1.8
5	2.3
6	2.7
7	3.2
8	3.6
9	4.1
10	4.5

1 short ton (2000 lbs) = 907 kilograms (kg)

Formula (exact):
pounds × .453 592 37* = kilograms

Volume

1 cu in = 16.39 cubic centimeters (cc)
1 cu ft = 28 316.7 cc
1 bushel = 35 239.1 cc
1 peck = 8 809.8 cc

Area

1 sq in = 6.45 sq cm
1 sq ft = 929 sq cm
= .093 sq meters
1 sq yd = .84 sq meters
1 acre = 4 046.9 sq meters
= .404 7 hectares
1 sq mile = 2 589 988 sq meters
= 259 hectares
= 2.589 9 sq kilometers

Kitchen Measure

1 teaspoon = 4.93 milliliters (ml)
1 Tablespoon = 14.79 milliliters (ml)

Miscellaneous

1 British thermal unit (Btu) (mean) = 1 055.9 joules
1 calorie (mean) = 4.19 joules
1 horsepower = 745.7 watts
= .75 kilowatts
caliber (diameter of a firearm's bore in hundredths of an inch) = .254 millimeters (mm)
1 atmosphere pressure = 101 325* pascals (newtons per sq meter)
1 pound per square inch (psi) = 6 895 pascals
1 pound per square foot = 47.9 pascals
1 knot = 1.85 kilometers per hour
25 miles per hour = 40.2 kilometers per hour
50 miles per hour = 80.5 kilometers per hour
75 miles per hour = 120.7 kilometers per hour

METRIC TO CUSTOMARY

Linear Measure

millimeters (mm)	fractions of an inch (to nearest 1/64″)
1	3/64-
2	5/64 +
3	7/64-
4	11/64-
5	13/64-
6	15/64 +
7	17/64 +
8	5/16 +
9	23/64-
10	25/64 +

Formula:

millimeters × .039 37 = inches

centimeters (cm)	inches (to nearest 1/64″)
1	25/64 +
2	25/32 +
3	1 3/16-
4	1 37/64-
5	1 37/32-
6	2 23/64 +
7	2 3/4 +
8	3 5/32-
9	3 35/64-
10	3 15/16-

Formula:

centimeters × .393 7 = inches

meters	feet (to nearest ¼ inch)
1	3′ 3¼ + ″
2	6′ 6¾-″
3	9′ 10 + ″
4	13′ 1½ + ″
5	16′ 4¾ + ″
6	19′ 8¼-″
7	22′ 11½ + ″
8	26′ 3-″
9	29′ 6¼ + ″
10	32′ 9½ + ″

Formula:

meters × 3.280 8 = feet

1 kilometer = 3280.839 8 feet

= .621 371 miles

Fluid Measure

1 milliliter (ml)	= .034- oz (fluid ounces)
10 ml	= .34- oz
100 ml	= 3.4- oz
1 liter	= 33.8 + oz
	= 2 pints, 2- oz
	= 1 quart, 2- oz

Formulas:

liters × 33.814 056 = ounces (fluid)

milliliters × .033 814 056 = ounces (fluid)

Weight

grams	ounces (avoirdupois)
1	.035 +
10	.353-
50	1.76 +
100	3.52-
500	1 lb 1.7- oz
1000	2 lb 3.3- oz

Formula:

grams × .035 273 99 = ounces (avoirdupois)

kilograms	pounds (to the nearest ounce)
1	2 lb 3 + oz
2	4 lb 7- oz
3	6 lb 9 + oz
4	8 lb 13 + oz
5	11 + lb
6	13 lb 4- oz
7	15 lb 7- oz
8	17 lb 10 + oz
9	19 lb 13- oz
10	22 lb 1- oz

Formula:

kilograms × 2.204 622 4 = pounds

1 metric ton (1000 kg) = 2 204.6 pounds

Volume

1 cubic centimeter (= 1 milliliter) = .061 + cubic inches

1 liter (1000 cc) = 61 + cubic inches

1 cubic meter = 35.3 + cubic feet

Area

1 square centimeter = .155 square inches

1 square decimeter = 15.5 square inches

1 square meter = 9.29 square feet = .84- square yards

1 hectare (10 000 sq. meters) = 2.47 + acres

Miscellaneous

1 newton (N) = 4.45- pounds of force

1 pascal (Pa) (pressure) = .000 145 + psi = .021- pounds per sq ft

1 kilopascal (kPa) = .145 + psi = 21- pounds per sq ft

25 kilometers per hour (km/h) = 15.5 + mph

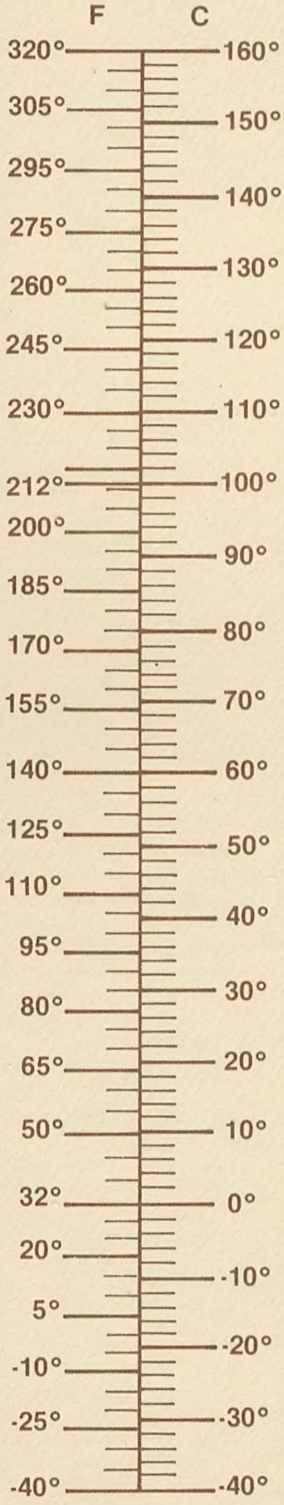
50 km/h = 31.1- mph

75 km/h = 46.6 + mph

100 km/h = 62.1 + mph

Formula:

km/h × .621 371 = miles per hour



32° Fahrenheit = 0° Celsius

0° Fahrenheit = -17.8° Celsius